MECHANICKS MAGAZINE,

AND

Journal of Publick Internal Improvement.

NO. 9. OCTOBER, 1830. VOL. I.

DR. LARDNER'S LECTURES.

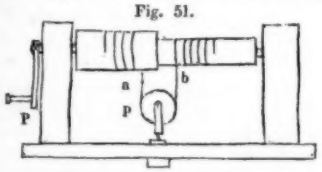
(Concluded.)

It is frequently required to estimate the amount of the pressure on the pivots, which is thus done:—Find the centre of gravity of the wheel and axle, and the weight of the machine will be divided between the pivots in the *inverse* proportion of their distances from the centre of gravity.

There are two ways of increasing the mechanical advantage of the wheel and axle; viz. first by *increasing* the radius of the *wheel* on which the *power* acts; and, secondly, by *decreasing* that of the *axle* on which the *weight* acts. In theory there appears to be no limits to either of these means, but in practice there are. In the first manner, the limit is the unwieldiness of the wheel; and with regard to the second, it may be asked, what are the cases where the mechanical advantage is desired to be increased? The combination is for raising a *heavy* weight; and on what part of the machine will this weight press, but on its axis? The axis, therefore, ought to be increased as much as possible, since by diminishing the axis the strength is reduced.

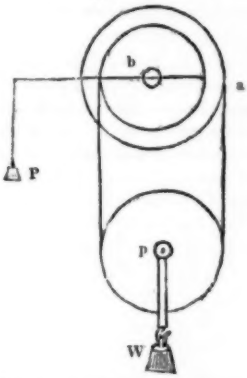
There is a very ingenious method of increasing the strength of a machine of this kind, without either of the above disadvantages. Fig. 51 is a front view, and fig. 52

Fig. 51.



a section of this combination (the same letters referring to the same parts in each.) It will be seen that a rope after being coiled round one part of the axis, and turned round the pulley *p*, is coiled in the *opposite* direction round the other part. Now, as the weight is supported by the two parts *ap* and *bp* of the rope, the tension of each part is equal to one half of the weight; consequently the difference of the products of the half weights, multiplied by the separate radii of the two axes, will give the

Fig. 52.

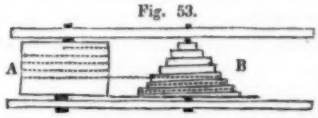


effective force; or, what is the same thing, the force is equal to the half weight multiplied by the difference of the two radii.

A varying lever is frequently useful in machines where the work to be done, or the load to be raised (whatever be the resistance,) is not uniform, while the power is so.

This is done by using a leverage which shall increase in power in the same proportion as the weight does: of which kind, one of the most beautiful instances is the fusee

Fig. 53.

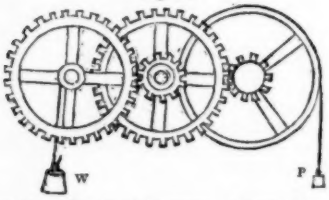


of a watch. The spring (which is the prime mover of the watch) is a spiral piece of steel; one end of which is fastened to the fixed axis of the barrel A, and the other to the barrel itself (the spring being enclosed in the barrel.) When the spring is wound up, its power is at its height; and as the watch goes down (to use a common phrase,) the spring loses its elasticity, and exercises a constantly diminishing force on the fusee B, round which the chain is coiled. This

fusee is of a conical figure, and the chain is fastened to the larger part of it at one end, while the other is fixed to the barrel. Now when the watch is wound up, the chain is wound on the fusee, so that when the spring is at its highest intensity, the leverage it acts at is at the smallest; and in proportion as the power (viz. strength of the spring) *decreases*, the leverage increases. If the elasticity be called E, and the radius R, ER will always express the whole effect.

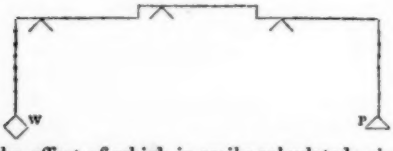
There is another way of increasing the power of the wheel and axle, without either of the disadvantages before mentioned: it is by means of what is called wheelwork—one wheel acting on another; and the series of wheels being connected either by straps, by friction, or by teeth. The first is a very common method, and is used in turning lathes and many other machines; the second is very uncommon, indeed hardly ever used. Wheels acting on one another by the third method, have a similar toothed-wheel fixed on the axle, which is called a *pinion*. The teeth of the large wheels are called cogs, but those of the pinion are called leaves. The cogs of one wheel act on the leaves of a pinion, on the axle of which is placed another wheel, whose teeth act in the same manner. Fig. 54 represents three

Fig. 54.



wheels acting in this way. It will be evident that this is nothing but the compound lever in another form; for if the upper and lower halves of the wheels be cut off, it will leave the system of levers as in fig. 55,

Fig. 55.

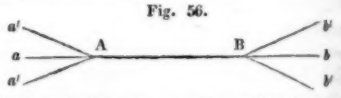


the effect of which is easily calculated; viz. the power is to the weight as the continual product of the arms of the levers presented *towards* the *weight* is to that of those turned *from* the *weight* or *towards* the *power*. But although this may be one way, yet it is not the practical method. The number of teeth in the wheels and the leaves in the pinions are found; and then the power is to the weight, as the continued product of all the leaves is to that of all the teeth.

Wheels are classed into three kinds according to their position; as, when the teeth are on the edge they are called spur-wheels or spur-gear (gear being a general term for all wheelwork;) when they are perpendicular to the wheel they are called crown-wheels, and they are bevelled-gear when the teeth are placed obliquely to the wheel.

The second class of elementary machines (viz. the cord) is now to be considered. It is this which has been generally called the pulley, although the cord is a better term for it, as the mechanical virtue does not depend on the pulley, but on the cord. The general principles are these:—A cord is supposed, in mechanicks, to be *perfectly* flexible. If two forces that are equal act in opposite directions on the same point, they will keep each other in equilibrium, and produce no effect, whatever the nature of the point, whether solid, fluid, or even gaseous; but if they do not act on the same point, but at distant points of the same body, they will or will not neutralize each other according to the circumstances. If the body be solid they will do so, in whatever direction they act, whether in the directions of any of the arrows in fig. 56; for by the

Fig. 56.



definition before given of a solid, it is incapable of either compression, extension, or flexure. If the body be a rope they will do so, if the forces act in the directions Aa or Bb, for a rope is supposed to be incapable of extension; but if they act in the opposite directions the rope will be compressed, and the forces will not neutralize each other's effects.

Another principle is its perfect capability of transmitting force in the direction of its length and from its ends.

Fig. 57.

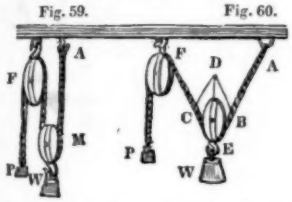
Fig. 58.

A form in which the rope is applied is the pulley, which is composed of a hollow shell, called a block, with a grooved wheel acting inside, and called the sheaf. In the simple pulley, as fig. 57, a string is passed over this sheaf; to one end of which is suspended the power P, and to the other the weight W.

Pulleys are divided into two sorts; viz. fixed (fig.57) and movable (fig. 58,) the names of which will sufficiently indicate their nature.

In the fixed pulley, the power and weight must be equal; for from the definition of the rope before given, each part of the string will be equally stretched by the power, and also by the weight, consequently they must be equal. It may be asked, of what use is this pulley? Its object is principally to change the direction of the force which is often of material consequence. Thus if a weight were required to be raised, a person acts to considerable disadvantage when raising any weight; but by means of

Fig. 59. Fig. 60.



a fixed pulley, a force applied in a downward direction (which is most effective) will raise the weight. Thus the object of a fixed pulley is merely to change the direction of a force, and no other mechanical advantage is gained by it.

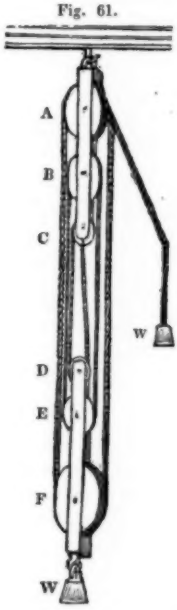
In a movable pulley, however there is a power gained; fig. 59 is a view of one. It will be seen that one end of the cord is fixed to the point A, and is continued round the *movable* pulley M; thence over the fixed pulley F. The power being suspended at the end P, the weight W is suspended to the movable pulley M. It is evident that the pulley M must move upwards with the weight, on the power being drawn downwards. Now, by the definition of a cord the tension of all the parts will be the same. As the weight is supported by the two cords (for they may be supposed to be unconnected) AM and FM, and each cord supports the same weight they must each support $\frac{W}{2}$; and as the power and weight are both equal when they are supported by a fixed pulley, the cord FP is also stretched with the same tension as FM; consequently P must be equal to $\frac{W}{2}$, or the power is equal to half the weight.

It has been asserted by some that the pulley depends, for its principles, upon the lever; but this can be proved to the contrary: for the same principles will be true, even if a point be supposed to be the pulley, and there can be no lever in that case.

In the last case, the strings were supposed to be parallel: the next proposition for consideration is when they are not so. Let fig. 60 be the pulley, and let AE and FE be the two directions of the strings: draw the parallelogram BECD; and if the sides BE and CE represent the tensions of the strings, the diagonal DE will represent the power.

It is evident from the foregoing cases, that in a single pulley the proportion between the power and weight can never exceed 1 to 2; but by combining a number of wheels in the same block, a very great degree of power can be gained. Let fig. 61

Fig. 61.



be a system of pulleys consisting of three wheels: for determining what proportion the weight bears to the power, it will be as well to trace the progress of the strings over the wheels. The end of it is fastened to the pulley C, and is passed under D; up again over C, under E; up again over B, from thence it proceeds under F, then over A; and on the other end is suspended the

power P. Now the weight is suspended by six strings; and as they are each stretched with the same tension, each string will be stretched with a tension equal to one-sixth of the weight: therefore the weight will be equal to six times the power.

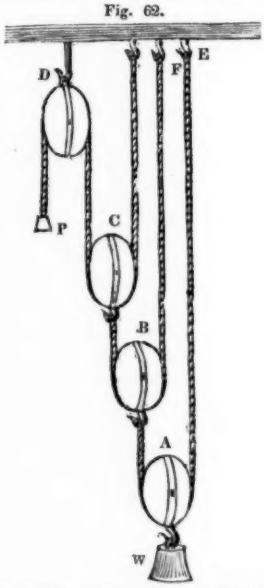
In general, the power is to the weight as the number of wheels in both blocks is to unity.

One objection to these machines is the friction, which is very great; every wheel having a separate axle, which must be taken into account.

The same observations apply to this machine as were before mentioned. A small force appears to balance a great weight: the weight and power are both thrown upon fixed points, which support them both. In the case of lifting—1 lb. weight raised 20 feet, requires the same force as 20 lbs. raised 1 foot, which is exactly the same thing that is effected by the pulley: it effects by gradual efforts what could not be done by a single exertion.

In the last cases there was but one string: now let there be more than one. Let fig.

Fig. 62.



62 be a system of pulleys, consisting of three movable (A, B, and C,) and one fixed (D.) Now, if the weight be supposed to be 8 lbs., it is plain that it is supported by the two ropes EA and BA; consequently they each support half that weight, or 4 lbs.: but the 4 lbs. supported by BA is also divided between the lines CB and FB, therefore they each bear a tension equal to 2 lbs.; and in like manner it can be shown, that the string DC bears a tension of 1 lb., and by means of the fixed pulley D, the power of 1 lb. will balance a weight W, equal to 8 lbs.

In all the last cases, the weight of the pulleys must be taken into account, which is often found to be very considerable. This inconvenience however, is remedied in the system represented in fig. 63, where

Fig. 63.

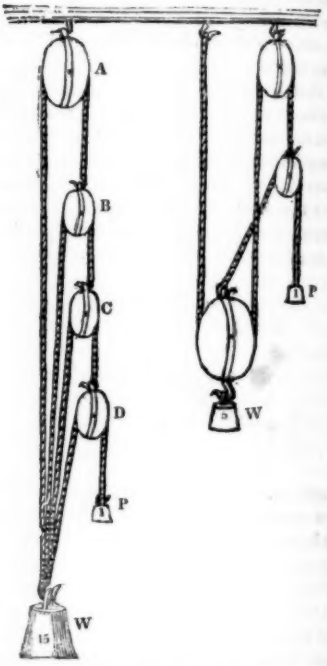


Fig. 64.

the weight of the pulleys assists the power. The proportion the weight bears to the power is thus found:—If the power be equal to 1 lb., it will bear a weight, suspended at the end of a string over the pulley D, equal to itself, or 1 lb. These two pounds together will balance a weight, suspended at the end of a string over the pulley C, equal to 2 lbs., which, added to the 1 lb. before, is equal to 3 lbs. Again, these 3 lbs., added to the power 1 lb. (viz. 4 lbs.), will balance the same weight over the pulley B, and which together with the former weight (3 lbs.) gives 7 lbs. for the weight; and thus by means of the other pulley A, may be increased to 15 lbs., which will be balanced by a power, P, equal to 1 lb. It will be plainly perceived that the

pulleys here assist the power in raising the weight.

The next figure (64) is called a Spanish Burton, the power of which is to the weight as 1 to 5.

One inconvenience attending pulleys with several strings is, that the ropes are not equally stretched, as is evident from what has been already mentioned.

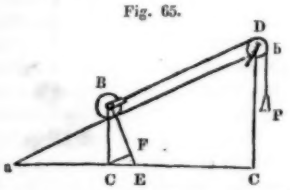
The results that would be obtained in *practice* would differ from those before given, on account of the friction which attends the number of pulleys which are used; but the investigation of the precise amount would require more mathematical science than the present Lectures will allow of.

The next class to be considered is the inclined plane, which is a plane raised at a certain angle to the horizon, or to the force intended to be resisted. If that force be gravity, it is at an angle to the horizon.

The screw and wedge are both machines of this class, but will be described hereafter.

Let fig. 65 be the inclined plane. The

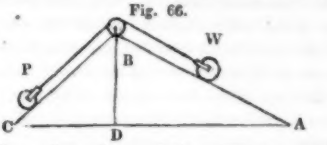
Fig. 65.



weight is generally applied at B, while the power acts in the direction BD, by means usually of a string BDP passing over a pulley D. The question then is, What must be the proportion between these two for them to be in equilibrium? It has been before mentioned, that three forces acting on a body will be in equilibrium where the three sides of a triangle drawn parallel to the direction of those forces are proportional to them. In this case there are three forces acting on the body B: viz. its gravity, represented by the line BC; the reaction of the plane, represented by BE at right angles to that plane; and the tension of the string acting in the direction of the power BD, and represented by the parallel line CF: consequently, the three forces are represented by the triangle BCF; or, what is the same thing, if the weight be in the same proportion to *ab* as the power is to *b*C, the resistance will be in the same proportion to *a*C. Thus, in any inclined plane the weight will be to the hypothenuse as the power is to the perpendicular, and as the resistance is to the base.

Two inclined planes are sometimes used, as at fig. 66; the one to support the power,

Fig. 66.



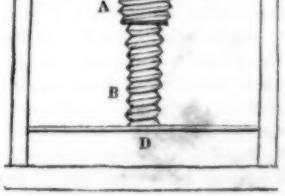
and the other the weight. Thus two inclined rail-roads are used, the power being an empty carriage descending, and the weight a full one ascending. In this case the power is to the weight as the lengths of the two planes, or P:W::AB:BC, and the pressure of the power is to that of the weight, as the bases of the two triangles, or as AD: DC, and the tension of the string will be represented by and equal to the common perpendicular BD.

The screw, which is the next mechanical power, is only a variety of the inclined plane; a little consideration will explain this. A hill is an inclined plane, but if that hill be wound round a pillar, it will still be an inclined plane, but it has then become the variety called a screw. A straight staircase is an inclined plane, but a spiral one is a screw.

In this machine, contrary to most others, the power acts in a direction parallel to the base, and the proportion is as follows; the weight is to the power as the circumference described by the power is to the distance between the threads of the screw.

The mechanical efficacy of this machine depends upon two things: viz. the closeness of the thread, and the size of the circumference of the action of the power. In *theory* there may be no limits to the range of the power or to the fineness of the screw, but there are *practical* limits. The range of the power is limited, as in the case of the wheel and axle, by the unwieldiness of it, if very large—while the fineness of the screw is limited by its strength. There is a very

Fig. 67.



ingenious machine called, from its inventor, "Hunter's Screw," represented at fig. 67.

In this case there are two screws made use of; the one, A, is a hollow cylinder, the interior of which is a nut adapted to receive the second screw B. The former one, A, works in a fixed nut *e*, and the other one, B, is attached to the movable board D. When the screw A is turned once round, it advances through the nut *e*, through a space equal to the distance between two contiguous threads, and (if the screw B were not supposed to act) the board D would descend the same space. But while the screw A advances through the nut *e*, the very same revolution causes the other screw B to move downwards through a space equal to the distance between two of its contiguous threads; consequently, if the threads of the screw A be wider apart than those of B, the combined effect will be that the board D will descend through a space equal to the difference of these intervals.

The mechanical efficacy is, therefore, increased by diminishing the difference of the distances between the threads of the screws. If the circumference described by the power be 20 inches, and one screw have 20 threads to an inch, and the other 21, the power will be to the weight as the difference between $\frac{1}{20}$ and $\frac{1}{21}$, or $\frac{1}{420}$ is to the circumference of the action of the power (20,) or as 1 to 8400. If, however, one screw has 30 and the other 31 threads to an inch, then the power is to the weight as $\frac{1}{30}-\frac{1}{31}=\frac{1}{930}$ is to 20, or as 1 is to 18,600.

A screw bears this remarkable difference to other machines—that in this machine the friction assists the power; indeed, it would otherwise be useless, for it is the friction which prevents it from recoiling.

One of the most curious applications of the screw is the instrument called a micrometer, which is used for measuring small spaces. A very fine wire is divided into parts, and placed parallel to the space to be measured. This wire is moved forward by means of a fine screw, being attached to the end of it, and at the other end of which is fastened an index, against which a fixed hand acts. The index is a circle divided into 100 equal parts. A screw can easily be constructed with the distance between its threads equal to only 1-100th part of an inch; consequently in one revolution of the screw it will be moved forward that distance, and when the index is moved *one* part, the screw will only be advanced 1-100th part of that distance, or 1-10,000th part of an inch. Smeaton constructed a micrometer by which he measured a space equal to 1-60,000th part of an inch.

The next, and last power, is the wedge, which is also only a variety of the inclined plane, consisting of two inclined planes joined together, as at fig. 68. ABC is the

Fig. 68.

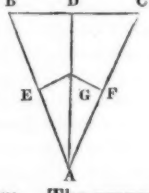


Fig. 69.

wedge. The proportion between the power and weight is found thus:—the wedge ABC may be considered as a triangle of forces, representing the power DG, and the two resistances formed by the pressures of the obstacle against the points E and F, represented by the two lines EG and FG, and which will be found, in the present instance, to be in favor of the power, and will be still more so were the resistances to act on the lower part of the wedge; which is the reason why a wedge is more effective on its being first applied to the resistance, as will be understood on inspection of the next fig. (67.) But all the *theory* of the wedge (which this is) is useless in *practice*, unless the force applied be pressure, for it is almost impossible to estimate the exact force of a blow. The only proportions that can be observed are, that the sharper the wedge is, the more powerful will it be.

From those who already are familiar with Mechanicks, we would ask indulgence for the space which the above lectures have occupied in our Magazine, did we not think it would be an insult to their good sense; for they well know that the science of Mechanicks, as illustrated in these lectures, although *old* to them, are *new* to a large portion of our community, and especially so to our youth; for whose advancement in knowledge every good citizen must feel a lively interest. The Editor of the London Mechanicks Magazine states, that these lectures were but preliminary to a course intended to make the student familiar with a more recondite series of lectures on Mechanical Science, and that probably he should be able, at some future time, to lay the notes of a second course before *his* read-

ers. If so, and we think the republication of them would prove instructive to *our* readers, we shall feel happy in again noticing Dr. Lardner's Lectures.—Ed.]

COMMUNICATION.] [FOR THE MAGAZINE.

PAVING.

The art of road-making, it is believd, consists in so constituting a road, as to exclude the water, and to resist, by the hardness, and tenacity of its parts, the action of wheels. McAdamizing with broken granite, seems to answer these two ends in a good degree, although some other stones might be found more durable; the flint, for example, which has been used in France for many years back, in the same way as is now practiced by McAdams. I have obtained one of the desired qualities, viz. dryness, by using broken plaster, or oyster-shells, which is of the same calcareous nature, on a wharf, where it is important to be free from mud. Perhaps the McAdamizing of our streets might be improved, and its consolidation accelerated, by covering the rough stone, in the beginning either with oyster-shells, or that broken plaster which is always found at the bottom of cargoes of that material, and is of no value as merchandize. It might be worth while to try an experiment on a small scale.

Paving, has been commonly done without much philosophy. We see every where, depressions and elevations, which soon require the whole paving to be taken up, and renewed. These inequalities are occasioned by the unequal resistance of the mass. Stones of widely different dimensions, in the first place, cannot form a continuous arch, if that be the form of the street. In the next place, a few small stones, near to larger ones, offer less resistance, and are soon depressed a little below the common level; that little, adds fresh power to the next wheel which rolls over them, it falls with an increasing impetus, from the higher stones, which do not yield, and the depression becomes more sensible every time; and soon produces those cavities, every where so visible.

It would be very easy to have the stones assorted by numbers, and stones of similar dimensions, always used in the same streets. The consistence of the bottom, is of no small importance; for although a bed of gravel be used, if a part of the foundation be clay, and another part, ruble or sand, and water be admitted to the former, the frost will heave in such places, and there will be less solidity at all times. A pavement with stones of uniform sizes, presents an even surface; and wheels of large diameter, or broad tires, will roll over it, as on a plain. But there is another kind of pavement, which if it be not too expensive, would be very perfect and durable. It is not new; the Romans used it in their streets and military roads, and the high way from Paris to Brussels, is principally of this sort. It is composed of cubes of about eight or nine inches, roughly split from the rock, but so nearly uniform as to present a very even surface, and gives a base, broader and more favorable for resistance, than common paving stones. The great durability of roads and streets, paved with such stones, must, it would seem, be attributed to the uniformity of size, and their form; for many of these old ways are laid on the ground, without cement or gravel. If the first cost of paving our streets with granite, so prepared, were even much greater than in the usual way, it might still prove an economy in the end. It would not be very difficult to form a pretty correct idea of the comparative cost and advantages; by first taking the primitive cost of common paving, and averaging the expense of repairs, yearly, on any given extent of a great thoroughfare: then to compare this aggregate cost, with that of a pavement with cubes of granite. There would still be some incidental items, not so easy to calculate, although they are apparent, and of no small importance to the publick; and they will be admitted by all enlightened magistrates, to be as worthy of consideration, on the score of economy, as any other saving. It is the wear and tear of carriages and horses, the economy of power, and the saving of time. Streets so paved, would be in fact, a sort of railway; and as experimental knowledge, is that which modern philosophers, seem determined only to rely on; it may be hoped that our city authorities may be induced to try the experiment, by laying down a few rods of this sort of pavement. FRANKLIN.

MINERAL FUSIBLE CEMENT.

In announcing the Mineral *Fusible* Cement for sale in England, it is right to state that it has been for some years in use on the Continent; particularly in *Sweden* and *Denmark*, whose engineers, after repeated trials, recommended it to their respective governments.

The Honorable *Board of Ordnance* in England, directed various trials of it to be made at the King's Mews, Pall Mall East,

in August last, in the presence of several officers of the Royal Engineers, and other scientifick gentlemen. The experiments were conducted under Captain Smith of the Royal Engineers; who was of opinion after repeated trials, that it was *impervious to water*, and that its *adhesive* qualities were greater than any cement he had ever known.

We shall only cite a few of the numerous trials made at the *King's Mews*, to shew its resistance to water and damp, and its powers of adhesion. 1st. A case of *wood* was *united* with the cement only, and *lined* with it; and in *less* than half an hour filled with water; it was perfectly tight. 2d. To shew its adhesive qualities, two plates of *iron*, four inches square, with a hook in each, were united with the cement by a seam or joint of one eighth of an inch; on being suspended, it bore a weight of upwards of eight hundred pounds before they separated. 3d. The flat side of a *brick* was united to an upright board by this cement, another to that, and so on, until the *twentieth* brick was attached; when one of the bricks split, but none of the joints gave way. This experiment was repeated frequently, but in every instance the cement proved stronger than the bricks. 4. A piece of *iron*, with a hook at the upper end and shank three inches long, was *inserted in a hole in a block of granite*, and there fixed with this cement instead of lead; the block of granite was attached *by the cement to another* of the same size, weighing *together* about three hundred pounds; the two were suspended by the hook, and *weights* to the extent of three hundred pounds were placed on the upper stone, but nothing gave way: the iron was not dovetailed at the bottom, and this weight (of *upwards* of six hundred pounds) was supported entirely by the adhesion of the cement to the iron plug and the granite.

Some further experiments were made at the *Tower* in December last, under the direction of Mr. Wright the clerk of the works; when one bushel of dry sand was found to weigh one hundred and thirty pounds, and one bushel of Mineral Cement in a solid body one hundred and fourteen pounds. These experiments were made with a composition of two hundred and twenty eight pounds of sand and one hundred and fourteen pounds of cement, mixed together by melting; and 1st. Two *bricks*, were united by a joint of one fourth of an inch with this guaged cement, and suspended by a chain which bore a weight of one thousand three hundred and forty-four pounds, when one of the bricks split; but the joint, with about one fourth of an inch of the brick attached to it, remained perfect. 2d. *Bricks were united* with this guaged cement, in the same manner as described in experiment No. 3 at the King's Mews, and extended to *eighteen* joints, when the second brick broke.

The cement being thus properly guaged, will unite *bricks* so firmly, that when coated with a mixture of three fourths sand and one fourth cement, they will form a solid body superior in strength and quality to sandstone; and applicable to similar purposes. From these experiments it is evident that the Mineral Fusible Cement possesses two invaluable properties, viz: *resistance to water and damp*, and powerful *adhesiveness*. Of the latter property we may observe, that wood may be united to wood, iron, stone, brick, tiles or slate; and any of these bodies to each other, indiscriminately; by means of this cement. [It may be added that it is very rare for one cement to suit so many objects.]

It is difficult to point out all the uses to which this valuable cement may be applied. Among the most prominent may be named, the formation and lining of tanks or cisterns, the lining of damp rooms or cellars, coating the outside of houses, which would effectually keep out damp—for *gutters* on the roofs of houses, instead of that expensive article, lead—for building turrets or minarets of churches—light-houses, where the firmest union of parts is required—the abutments of a series of arches—*fastening iron railings in stone copings*—preserving wood in damp foundations, by coating it with cement—in jointing stone copings, rendering the use of lead or iron cramps *unnecessary*—lining the inside of churches, to preserve them from damp—and the inside of boxes for packing merchandize which requires to be kept from sea damp—and *uniting iron pipes* either for water or gas, more effectually than by lead or any other substance; and for which purposes a mixture composed of two *parts* of dry sand with one part of Mineral Cement, may be applied with great advantage and economy. It is also applicable in its *pure* state for coating the bottoms of *canal boats instead of copper*.

The Mineral Fusible Cement is prepared and *sold in casks or packages* of various sizes, accompanied by proper directions for its use.

N. B. When a parcel of cement is sent for, an account of the mode of using it, is added; and a set of the implements neces-

sary (which are cheap,) may be got as patterns for making more.

It is known that the Duke of Wellington, who has been at the head of the English Board of Ordnance, and Mr. Nash, the architect of the king of England, are in favor of this cement.

Directions for its use.—To be heated in an iron kettle or pot, on either a coal or coke fire, to the temperature for *melting lead*, when used either in its pure state or guaged.

This cement may be *guaged* with dry, sharp sand, in any proportion as required, *not exceeding three fourths sand to one fourth of cement*, under any circumstance; such guaging being by weight, and not in bulk or measurement; taking care to well mix the same while heating.

Such materials and parts as are intended to be used with, or worked upon by this cement, must be quite dry, or no adhesion thereto will take place.

When the cement in the small kettle becomes too cold for use, it may be remelted, without its strength or virtue being deteriorated.

The inside of tanks or cisterns may be rendered or lined with this cement, and made perfectly water proof, *with a thickness of one fourth of an inch*, (instead of three fourths, as with other cements,) when guaged with an *equal* proportion of *sand*; such tanks or cisterns if made of *brickwork* being built with or set in this cement; thereby making close joints; but if of wood, slate, iron, or other substances, they will *only* require jointing therewith.—(Silliman s Jour.)

CHYMISTRY.—OF THE METALS.

Gold.—If a narrow slip of gold leaf be put, with both ends hanging out a little, between two glass plates tied together, and a strong electrical explosion be passed through it, the gold leaf is missing in several places, and the glass is tinged of a purple color by the portion of the metal which has been oxidized. This curious experiment was first made by Dr. Franklin; it was confirmed in 1773 by Camus. The reality of the oxidizement of gold by electricity was disputed by some philosophers, but it has been put beyond the reach of doubt by the experiments of Van Marum. When he made electrick sparks from the powerful Teylerian machine pass through a gold wire suspended in the air, it took fire, burnt with a green-colored flame, and was completely dissipated in fumes, which, when collected, proved to be a purple-colored oxide of gold. This combustion, according to Van Marum, succeeded not only in common air, but also when the wire was suspended in hydrogen gas, and other gases which are not capable of supporting combustion. The combustion of gold is now easily effected by exposing gold leaf to the action of the galvanick battery. Dr. Thomson made it burn with great brilliancy, by exposing a gold wire to the action of a stream of oxygen and hydrogen gas mixed together and burning. Now in all cases of combustion the gold is oxidized. We are at present acquainted with two oxides of gold: the *protoxide* has a *purple* or violet, the *peroxide* a *yellow* color.

Of these the *peroxide* is most easily procured; it is therefore best known. It may be procured in the following manner: equal parts of nitrick and muriatick acids are mixed together,* and poured upon gold; an effervescence takes place, the gold is gradually dissolved, and the liquid assumes a yellow color. It is easy to see in what manner this solution is produced. For it is worthy of remark, that no metal is soluble in acids till it has been reduced to the state of an oxide. There is a strong affinity between the oxide of gold and muriatick acid. The nitrick acid furnishes oxygen to the gold, and the muriatick acid dissolves the oxide as it forms. When nitrick acid is deprived of the greater part of its oxygen, it assumes a gaseous form, and flies off in the state of *nitrous gas*. It is the emission of this gas which causes the effervescence. The oxide of gold may be precipitated from the nitro-muriatick acid, by pouring in a little potash dissolved in water, or even by lime water. It subsides slowly, and has a yellowish brown color, and sometimes, indeed, approaches to black. When carefully washed and dried, it is insoluble in water and tasteless. When this oxide is moderately heated, it becomes purple. A stronger heat expels the whole of the oxygen, and reduces it to the metallick state.

The properties of the *protoxide* of gold are but little known. It is formed when the metal is subjected to combustion, or to the action of electricity, and likewise by exposing the peroxide to the proper degree of heat, or even by placing it in the rays of the sun. Its color is purple. Various

* This mixture, from its property of dissolving gold, was formerly called *aqua regia*, (for gold, among alchymists, was the king of metals;) it is now called *silver muriatic acid*.

preparations containing it are used in the arts, which will be noticed afterwards.

Hitherto gold has been united artificially to none of the simple combustibles except phosphorus. Hydrogen and charcoal are said to precipitate it from its solutions in the metallick state.

Sulphur, even when assisted by heat, has no action on it whatever; nor is it ever found naturally combined with sulphur, as is the case with most of the other metals;—yet it can scarcely be doubted that sulphur exercises some action on gold, though but a small one; for when an *alkaline hydro-sulphuret* is dropt into a solution of gold, a *black powder* falls to the bottom, which is found to consist of gold and sulphur, either combined or intimately mixed; and when potash, sulphur, and gold, are heated together, and the mixture boiled in water, a considerable portion of gold is dissolved. Three parts of sulphur, and three of potash, are sufficient to dissolve one of gold. The solution has a yellow color. When an acid is dropt into it, the gold falls down united to the sulphur in the state of a reddish powder, which becomes gradually black.

Gold does not combine, as far as is known, with either of the simple incombustible bodies.

But gold combines readily with the greater number of the metals, and forms a variety of alloys.

This metal is so soft, that it is seldom employed in a state of purity. It is almost always mixed with small quantities of copper and silver. Goldsmiths usually announce the purity of the gold which they sell in the following manner: Pure gold they suppose divided into 24 parts, called *carats*. Gold of 24 carats means pure gold; gold of 23 carats means an alloy of 23 parts gold, and one of some other metal; gold of 22 carats means an alloy of 22 parts of gold, and two of another metal. The number of carats mentioned specifies the pure gold; and what that number wants of 24, indicates the quantity of alloy. Thus gold of 12 carats would be an alloy containing 12 parts gold, and 12 of some other metal. In this country, the carat is divided into four grains; among the Germans into 12; and by the French it was formerly divided into 32.

Platina.—Platina, or platinum, was not known by Chymists till the middle of the eighteenth century. Under this name, however, which is of Spanish origin, and signifies *little* or inferior *silver*, some white trinkets of little estimation were sold, before the metal was distinctly known. Antonio de Ulloa, a Spanish mathematician, who accompanied the members of the French academy, in their famous voyage to Peru, for the purpose of ascertaining the figure of the earth, first gave something like a precise notion of it, in the account of his voyage published at Madrid in 1748. It is observed, that Mr. Charles Wood, an English metallurgist, brought some of it from Jamaica in 1741. This gentleman related some experiments on this new metal in the Philosophical Transactions for 1749 and 1750.

These first experiments, which announced very extraordinary properties, made a great noise in Europe, at a period when the discovery of a metal, particularly one so singular as this appeared to be, was a phenomenon beyond what any one had dared to hope. The greatest Chymists of Europe were then eager to examine platina, and investigate its distinguishing characters. Scheffer, a Swedish Chymist, gave the first accurate series of experiments on this metal, in the Memoirs of the Academy of Stockholm, in 1752; in consequence of which, he ranked this metal near gold for its properties, and called it *white gold*. Lewis, an English Chymist, to whom we are indebted, among other things, for a history of silver and gold, very complete for the time, made a very extensive and regular series of experiments on platina, which he published in the Philosophical Transactions for 1754. In the Memoirs of the Academy of Berlin, for 1757, Margraff gave an account of his experiments on this metal. All these early labors were collected and compared by Morin, in a work he published in France, in 1758, under the title of *Platina, White Gold, or the Eighth Metal*. This is a methodical compilation of all that had been done previous to that period.

After these researches, already very numerous, Achard, Guyton, Lavoisier, and Pelletier, successively published methods of obtaining platina pure, and of fusing it, and new information respecting its combinations.

From these combined labors, we have acquired a considerable knowledge of the properties of platina, though there are still many things desirable for completing the history of this metal. The Pneumatick system has done nothing with regard to platina, except teaching us to place it on a level with gold in respect to its difficult oxidation, its little affinity for oxygen, and its conso-

quent unalterability by the majority of other substances.

Platina, when purified, is of a less beautiful white than silver, and verging a little towards the grey color of iron. When burnished, it has a blackish tint, and not the white lustre of silver. Its unpolished parts are somewhat grey and dull. Its appearance is not so brilliant and pleasing as that of silver, or gold; and most men, though likely to confound it with other metals, would not form from the sight of it the same idea as of those two precious metals which attract their eyes and excite their admiration, or attach to it the same value.

This metal is the most dense and heavy of all natural substances. When it is slightly hammered or forged, its specifick gravity is 21·5, and after being well hammered, it is 23.

The elasticity of platina appears to be pretty considerable. Its ductility is great, though it is far from being easily wrought, it is reduced to very slender wires, and very thin leaves. Guyton gives it the second rank in this respect, placing it between gold and silver. It is easily bended; and the resistance and cohesion of the plates fabricated of it will, at some future period, admit a great number of uses to be made of it of high importance. The same Chymist made the most accurate experiments on its tenacity, or the cohesion of its particles. In this point, he assigns it the third rank after iron and copper, and before silver and gold.

Platina, like all other metals, heats quickly, and is a very good conductor of calorick. Borda found that its dilatation is $\frac{1}{832000}$ to a degree of Reaumur's, and $\frac{1}{1160000}$ to a degree of the decimal thermometer. Of all metals it is the most intractable in the fire, and the most difficult to fuse. It goes beyond iron and manganese in this property. Guyton estimates its fusibility at a degree yet unknown, or beyond the utmost limit of Wedgewood's pyrometer. In fact, the greatest fire produced by our furnaces scarcely soften, perceptibly, the platina, in grains. At the most extreme degrees of heat, we can only agglutinate these grains together, without imparting to them a true or strong adhesion, since they may be separated by hammering. Macquer and Baume kept several in a continued line, exposed to the constant and violent heat of a glass-house furnace; and these grains only stuck slightly to each other, for they were afterwards separated by the hand. They perceived their color become very brilliant, when they were at a white heat. On exposing the same grains of platina, well purified, to the focus of the burning lens of the Academy, the portions placed in the centre of the focus smoked, melted at the end of a minute, and formed an homogeneous button, white and brilliant, very ductile, and capable of being cut with a knife. Guyton likewise succeeded in fusing small portions in a crucible, by the help of his reducing flux, composed of eight parts of pounded glass, one of calcined borax, and half a part of charcoal, and employing for this operation Macquer's wind furnace. Lavoisier also fused small portions of platina in a cavity on charcoal with a blast of oxygen gas. After all these trials, there is nothing more easy than to procure little buttons of this metal thus melted; but they are in such small masses, that it is impossible to employ them in decisive experiments; and we may still say that no real and useful fusion of platina has been obtained; since, when treated by the ordinary means, it is impossible to fuse it in such a quantity as allow us to examine its properties, and employ it in experiments capable of rendering us acquainted with them. Accordingly it will appear farther on, that, to apply it to the uses already made of it, the fabrication of plates, bars, wires, vessels, &c. it has been necessary to fuse it by the help of some alloys, and separate it afterwards by forging from the metals united with it.

Platina is a very good conductor of the electrick fluid and of galvanism. Its power in this respect has not been compared with that of other metals, but it appears to be very great. It has neither smell nor taste, in which it resembles silver and gold.

Platina has hitherto been found no where except in the gold mines of America, particularly in that of Santa Fe, near Carthagena, and in the bailiwick of Choco, in Peru. It is collected in the form of little grains, of a livid grey or white, the color of which partakes of those of silver and iron. These grains are mixed with several foreign substances; among them are found gold dust, blackish ferruginous sand, grains that appear thro' the lens scorified like the slag of iron, and some particles of mercury.

On examining the grains of platina with a lens, some appear angular, and others rounded or flattened like some pebbles. They may be flattened under the hammer, but some fly to pieces; and these frequently

appear hollow within, and contain portions of iron and a white powder. To these small grains of iron must be ascribed the property of being attracted by the magnet, observed in the grains of platina, though well separated from the ferruginous sand among them. To obtain the purest and largest grains of platina, they are sorted by hand, and the gold dust, quartz, sand, and iron, are separated from them.

It is probable that platina is not found in the earth as it is brought to us, and as it is seen in mineralogical collections. The form of grains which it exhibits is owing either to the motion of the water by which it is carried down from the mountains into the plains, or to the grinding of the mills, through which the ores of gold with which it is mingled in the native state are passed. Sometimes pretty large pieces of it have been found. No naturalist has yet described the situations or varieties of ores of platina. It is at present the least known of all metals, and perhaps the only one which, being found hitherto only in one state, been likewise discovered but in one single country.

Platina is very distinguishable by its form, color, and specifick gravity. As it is always mixed with sand and iron, and frequently with gold and quicksilver, beside the sorting by hand already mentioned, by means of which Tillet found some grains of this metal embedded in a quartz gangue, different processes are employed for its purification. It is heated red hot to volatilize the portion of mercury left by the amalgamation, by means of which gold was obtained from it. Iron is separated from it by the magnet, which frequently takes up with this attractable metal little fragments of platina. The grains are also heated with muriatick acid, which dissolves and takes up the iron. Bergman has remarked, that platina loses 0.05 of its weight by this operation. After this, nothing remains but the platina and the gold, both of which are to be dissolved in nitro-muriatick acid; and the proportions of the two metals may be found by precipitating the gold by sulphate of iron, and carefully weighing the precipitate, which, as we have before observed, is in a metallick powder.

As to operations in the great way, there is no one yet settled or practised. The Spanish government, having found that its miners debased gold with platina, and that it was difficult to discover the fraud, on account of the specifick gravity and unalterableness of this compound, is said to have shut up the mines of platina; but this is an improper expression, which requires to be explained so as to leave no ambiguity or uncertainty. It appears that platina, being always found mixed with gold ore, and both being disseminated in the native state, in the same gangue, it is impossible that the mines of platina can have been shut; but as fast as this metal, which does not dissolve like gold in quicksilver, is extracted and separated, it is thrown away, or set apart, so that it is no longer met with in trade as formerly. Hence it is, that the mode of treating it in the large way has made no progress, and that no work in this new branch of metallurgy has hitherto been erected.

Accordingly, what belongs to the metallurgy of platina is nothing more than a series of operations on a larger scale than those of a simple assay, though on a much less than the usual metallurgick operations. It is by these that Carrochez, Jeannety, Chabanon, Wollaston, and several others, have accomplished the fusion, particularly by the help of arsenious acid, or what is called white arsenick, of some considerable quantities of platina; they have hammered and forged it by repeatedly heating and softening it, so as to deprive it by little and little, and at length completely, of the arsenick which rendered it fusible, and preserved its continuous and connected form, so as to admit of its being flattened, fashioned on moulds, and drawn into wire. It is by a similar operation that it has been brought to the greatest purity, reduced to the common state of other metals, and made to assume forms which may render it useful for various purposes.

As the different processes employed by most of the artists above mentioned for purifying, fusing, and forging platina, have not yet been described, we shall here state one of the simplest which has yet been employed. Dissolve the grains in diluted nitro-muriatick acid with as little heat as possible. Decant the solution from the black matter which resists the action of the acid. Drop into it a solution of *sal ammoniac*. An orange yellow colored precipitate falls to the bottom. Wash this precipitate, and when dry, expose it to a heat slowly raised to redness in a porcelain crucible. The powder which remains is platinum, nearly pure. By re-dissolving it in nitro-muriatick acid, and repeating the whole process, it may be made still purer. When

these grains are wrapt up in a thin plate of platinum, heated to redness, and cautiously hammered, they unite, and the whole may be formed into an ingot.

It cannot be combined with oxygen, and converted into an oxide, by the strongest artificial heat of our furnaces. Platinum, indeed, in the state in which it is brought from America, may be partially oxidized by exposure to a violent heat, as numerous experiments have proved; but in that state it is not pure, but combined with a quantity of iron. It cannot be doubted, however, that if we could subject it to a sufficient heat, platinum would burn, and be oxidized like other metals: for, when Van Marum exposed a wire of platinum to the action of his powerful electrical machine, it burnt with a faint white flame, and was dissipated into a species of dust, which proved to be the oxide of platinum. By putting a platinum wire into the flame produced by the combustion of hydrogen gas mixed with oxygen, he caused it to burn with all the brilliancy of iron wire, and to emit sparks in abundance.

To obtain the oxides of this metal, it is necessary to have recourse to the action of an acid. When the deep brown solution of platinum in nitro-muriatick acid is treated with lime water, a yellowish brown powder falls. Dissolve this powder in nitrick acid; evaporate to dryness, and apply a heat sufficient to drive off the acid. The brown powder which remains is the peroxide of platinum. It is tasteless and insoluble in water. When heated to redness, the oxygen is driven off, and the oxide reduced to the metallick state. One hundred and fifteen parts of oxide, by this treatment, leave 100 parts of metal.

If the heat in this experiment be very cautiously raised, the oxide, before it is reduced, assumes a green color. This change is occasioned by the separation of a portion of the oxygen. The green colored powder is, according to Chenevix, a protoxide of platinum.

The action of the simple combustibles on this metal is not more remarkable than their action on gold.

Neither hydrogen nor carbon have been hitherto combined with it.

Phosphorus unites with it easily, and forms a *phosphuret*. By mixing together an ounce of platinum, an ounce of phosphorick glass, and a dram of powdered charcoal, and applying a heat of about 32° Wedgewood, Mr. Pelletier formed a *phosphuret* weighing more than an ounce It was partly in the form of a button, and partly in cubick crystals. It was covered above by a blackish glass. It was of a silver white color, very brittle, and hard enough to strike fire with steel. When exposed to a fire strong enough to melt it, the phosphorus was disengaged, and burnt on the surface. He found also, that when phosphorus was projected on red hot platinum, the metal instantly fused and formed a phosphuret. As heat expels the phosphorus, Mr Pelletier has proposed this as an easy method of purifying platinum.

Platinum cannot be made to unite to sulphur by heating them together. In this respect it resembles gold; yet there seems to be an affinity between the two substances; for when the metal is heated with a mixture of potash and sulphur, it is corroded and rendered partly soluble in water, as was proved by the experiments of Lewis and Margraff. And when sulphuretted hydrogen gas is passed into a solution of platinum in an acid, the metal is thrown down in dark brown flakes, apparently in combination with sulphur. Indeed, if we believe Mr. Proust, a sulphuret of this metal occurs sometimes mixed with native platina.

Platinum, as far as is known, does not combine with the simple incombustibles.

It combines with most of the metals, and forms alloys, which were first examined by Dr. Lewis.

COMMUNICATION.] [FOR THE MAGAZINE.

PRIVIES.

There is a law, in this city, I understand, prohibiting the citizens from connecting their vaults with the common sewers, on account of the smell, which may thus be communicated to the houses. Our city claims the honor, I believe, of an invention called a sess-pool, which is an effectual remedy for the evil alluded to. Moreover, no smell can be worse than that which proceeds from decayed vegetables, and other impurities, which commonly go into the common sewers.

Now, instead of a law to prevent this draining of the vaults through the common sewers, to the ocean, which surrounds the city, it would seem desirable to have a law commanding it to be done; and the reasons are obvious. The operation of voiding the privies is offensive, unhealthy, and expensive; and its repetition is increased in an immense ratio, by the retention of the liquid contents. Frequently in old buildings, the

construction of these places is so imperfect, that the rain, or the drains from the houses, find a way into them, and require the disgusting night work, several times in a year. With regard to the health of the citizens, to show the effect which a repetition of these operations may have, or perhaps worse, from their neglect, in the case of overflowing, I need only refer to the reports of the Faculty presiding over the Hospitals, and other charitable institutions of Paris, in relation to an invention, called by its author, an *Inodorous Privy*, which attracted much notice in Paris, London, and other great cities, some years ago. The presiding officers, and medical gentlemen who visited these institutions in Paris, reported, that those patients whose beds were situated near to the privies, were, almost invariably, more difficult of cure, and subject to greater mortality, than others, with similar disorders, but situated at a distance from those places. The surgeons also reported, that wounds were observed to be of obstinate durability, and resisted the common, and usually successful treatment in such vicinities. These, and other facts, caused the invention to be adopted in all these institutions. The water from one of the wells was analyzed, and found to contain much impurity, of vegetable, and animal origin.

Such facts, it would seem, ought to command the serious consideration of all intelligent and humane magistrates. And when we consider how very compact we are now building up this city, and the sources from whence we draw all the water we use, and the consequences which might be apprehended from a combination of those causes of endemical disorders, which are generated by a peculiar state of temperature, with such as have been described, these consequences will be truly appaling.

This subject is not only worthy of attention in the view of humanity; but with a calculating, money making people, it is a matter of serious pecuniary concern. It is quite easy to imagine the depopulation of whole streets and wards, and the consequent ruin of the proprietors of estates located therein. The city treasury also, is subject to a large defalcation of income, from similar causes.

It is well known that much of the ground on which this city is built, is of a very loose composition. It is equally well known, that the mode of securing the vaults, and drains, is very imperfect. It must be evident too, on the slightest reflection, that the greater the height of the fluid in the vaults, the greater the pressure, and consequently, the more copious must be the percolation of that fluid through the ground to contaminate the springs of water. Much more of the water in our wells, proceeds from the surface than we are aware of: how otherwise shall we account for the failing of those copious springs, which formerly made our wells to overflow? When our city was a *run in w-ba*, and contained vastly more vacant land, in gardens, than houses and paved streets, the rain found its way to the wells, and kept them well supplied. Now the roofs of the houses, and the pavements, conduct the water to the ocean; and thus by diminishing the quantity of the water, increase the ratio of the corrupting causes noticed above.

If the vaults were tapped, a few feet below the upper surface, and their liquid contents, allowed to find an issue to the sea, through the common sewers, the pressure would be diminished, and then, such earth as would be easily penetrated by a liquid, under the pressure of ten feet, would be quite imperviable under one of five feet; by this means, much of it would be prevented from going to adulterate the water we use. The saving to the citizens may be easily imagined; especially to the poorer classes, whose accommodations are the least perfect, and require the operation of cleansing the most often. The saving of the doctor's bill, and the saving of time, independently of more refined considerations, will, it is hoped, recommend this subject to the attention of those who believe, that political economy, well understood, is to be the basis of our future progress in physical and moral science.

When the wants of agriculture shall require, and can afford to pay the expense of saving, all *kinds* of manure, other modes may be adopted, similar to some now practised in old countries. But for the present, we can afford to sacrifice something to the comfort, and health, of a population, which has *yet* something to spare; and which it may be hoped, may *continue long* in this happy state of independence, and not be obliged to imtiate too rigidly, the degrading expedients of less fortunate societies. To that effect, it behooves the people to be very cautious how they admit into this happy country, laws, usages, and *unnecessary* occupations, which may tend to destroy this enviable *mediocrity*; this *equality*, no where else to be found, and which is the only sure foundation of our present form of government.

STERCOLANUS.

IMPORTANT SUGGESTIONS.

The writer of the following letter has pointed out an improvement, in our opinion so obvious, and of such vast importance, that we regret that he did not some time since suggest it to the Railway Committee. The hint may be so useful to the nation at large, that our contemporaries throughout the country would do well to give it all the additional publicity in their power.—*Editors of the Liverpool Mercury.*

To the Editors of the Liverpool Mercury.

GENTLEMEN,—Here is an improvement in the construction of railways, and in the adaptation of locomotive engines to them, which is so obvious and so important, that I cannot conceive how it can have been overlooked, nor, if it has been perceived, why it has not been adopted. It consists in the mere addition to the outward edges of the rails on inclined planes of a *raised* flange or range of cogs, and of corresponding cogs on the power-wheels of the locomotive-engines, at a proper *distance from the rim* of the wheels, to work in the interstices of the cogs on the rails. These little alterations would render fixed engines on railways quite unnecessary, and the necessity of deep cuttings and very high and long embankments would be very much lessened; for as the locomotive-engines would, with their loads, either ascend or descend considerable elevations or declivities, the inclined planes might be made steeper and shorter, with the further advantage of greater length in the level part of the road. On this, as the rails would be without the raised cogs, and plain as now, and the cogs on the rails would not come into contact with them, the application and efficiency of the locomotive-engines would be exactly the same as on the railways hitherto constructed for them. If the Liverpool and Manchester Railway had been thus, what I will call a "mixed railway," instead of being composed of plain rails throughout, the fixed engine at the upper end of the tunnel would not have been in the least degree requisite, and the expense of fuel for it, of men to work it, of the ropes and other tackle attached to it, would have been saved; and the danger there is of the ropes breaking, and probably loss of lives, as well as the damage of whatever may be in the way of the loosened wagons descending with irresistible rapidity and force, would have been avoided; the inclined plane at Rainhill would have been much shorter—heavier loads might be dragged up it, and if not with greater speed, (which, however, I think they would be,) the greater length of level road would, upon the whole, have compensated for any delay which could be occasioned by the cogs and somewhat steeper ascent. On the Bolton Railway a charge is made for dragging up the planes of 8*d.* per ton, and of 6*d.* per ton for letting down, which would have been quite unnecessary had that railway been made on the mixed principle here suggested; and I have no doubt that by this the speed of ascending and descending would have been greater than is practicable by fixed engines and ropes.

Unless I am mistaken in my view of the matter, the "mixed railway" will come into general use; and not only facilitate, but obviate all difficulty in the making railways for the general purposes of roads throughout the country. T. H.

Extract from a Second Letter.—I am, however, aware that there is some difficulty to overcome in giving the mixed railway the most perfect effect; and my motive in now addressing you on the subject is to point out this difficulty, still hoping for the furtherance of the scheme by the detail and discussion of it in your paper.

When a locomotive-engine, coming along the plain part of the railway, arrives at the range of cogs, it may happen that the cogs of the wheel will be so situated as to fall upon the cogs of the railway instead of the interstices; and the difficulty is to make the engine enter upon the cog-railway without any jolt or check, and without the necessity of stopping, or of its speed being much lessened. I entertain no doubt of this being accomplished by a proper formation and arrangement of the cogs on the wheels and those on the railway, and a gradual commencement of the latter; but of the most eligible mode that can be devised, I am far from confident. Should some of your readers, who are engineers or mechanicks, give their best consideration to the matter, perhaps they may hit upon some invention for the purpose, which, under a patent, will amply remunerate them.

COMMUNICATION.] [FOR THE MAGAZINE.

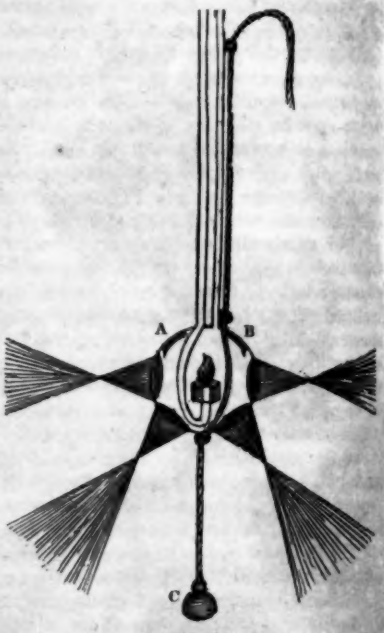
MR. EDITOR,—In your last number there is an article on the "Combustion of Ashes," extracted from a New York paper, [the Western Spectator] which if true, should be generally known; if not, it should be refuted. The writer bespeaks his theory by in-

sinuating, that it is not probable that coals can remain on fire when buried in ashes, and that if they should, it is not likely they can fire any combustible.—As every person knows better than this, it needs no refutation. He asserts that hard wood ashes, which has not been exposed to damp, contains potassium, which is set on fire by moisture; though he does not say that he or any other person ever *saw* this phenomenon. The writer justly remarks, that the slacking of lime is quite different from combustion. If any component part of wood be *very* combustible, it seems that when the less inflamable parts are burning, this might undergo a similar operation, without the agency of *water to set it on fire*. But to predict with certainty what will take place, we must have recourse to experiment, or to a minute investigation of the properties of this metal. I have wet ashes many times without discovering that it had the least tendency to inflame it; nor do I know that any person ever *saw* any such tendency. But this does not prove that it will not happen, when some of the circumstances are a little different. Let us next consider the properties of potassium, to see whether such a combustion is probable. It is well known to chymists, that when potassium is exposed to atmospherick air, it very soon combines with oxygen and becomes incapable of combustion; therefore none of it exists in a combustible state in ashes which has been at all exposed to the atmosphere. Potassium is susceptible of combining with a larger portion of oxygen than exists in potash; this compound is called *peroxide of potassium*. But it is difficult to form this combination. And if this peroxide be exposed to water, it immediately evolves a part of its oxygen and is reduced to potash. Potash has so great affinity for water, that when heated red hot, it will still hold a large quantity of water in combination. Dry potash will absorb water from the atmosphere. Therefore, if the potash of new ashes be dry, it will absorb water when exposed to damp. I do not know that the temperature of potash rises any during its absorbing water. It is also known that potassium has a greater affinity for oxygen than coal or almost any known substance, when its temperature ranges from zero to that of our common fires, therefore, if any of it were in a common fire, it would burn, to the exclusion of coal or almost any substance with which we are acquainted; therefore none of it exists deoxidized in the ashes of a common fire. It seems probable from an experiment of Prof. Woodhouse, that when potash is confined in a close vessel with soot, and raised to an intense heat, that the potash is decomposed. If any persons should infer from this that potassium may exist deoxidized in the ashes of a very *hot fire*, they should recollect that when it is heated only red hot, and excluded from oxygen to prevent its burning, it immediately evaporates. Hence it seems that it cannot remain in a very hot, or even a common fire, if it be not confined. Therefore, we have good reason for supposing, till some such thing be observed, or till some recondite property of it, which would make it seem more probable, shall be discovered, that no such combustion happens.

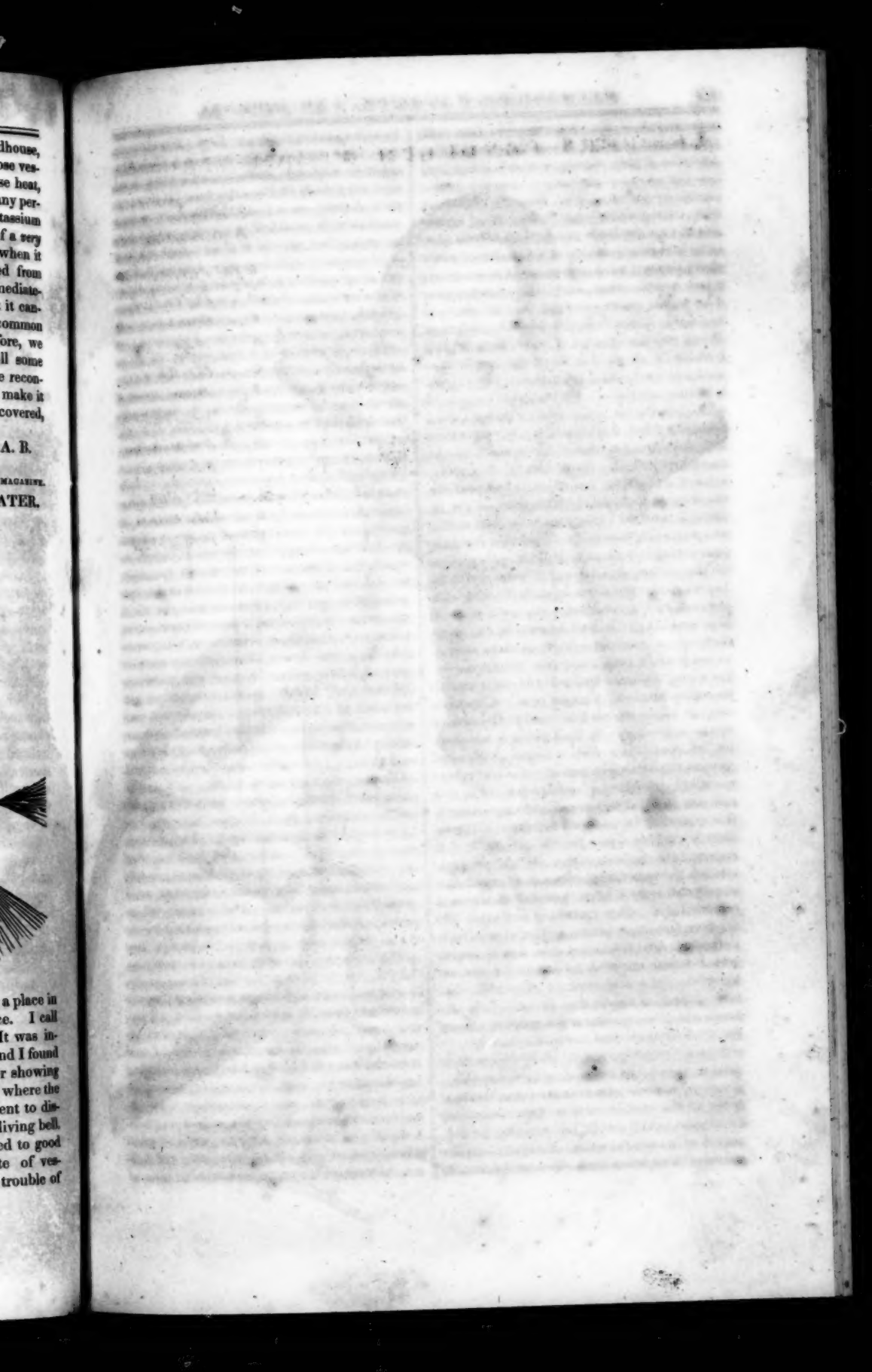
U. A. B.

COMMUNICATION.] [FOR THE MAGAZINE.

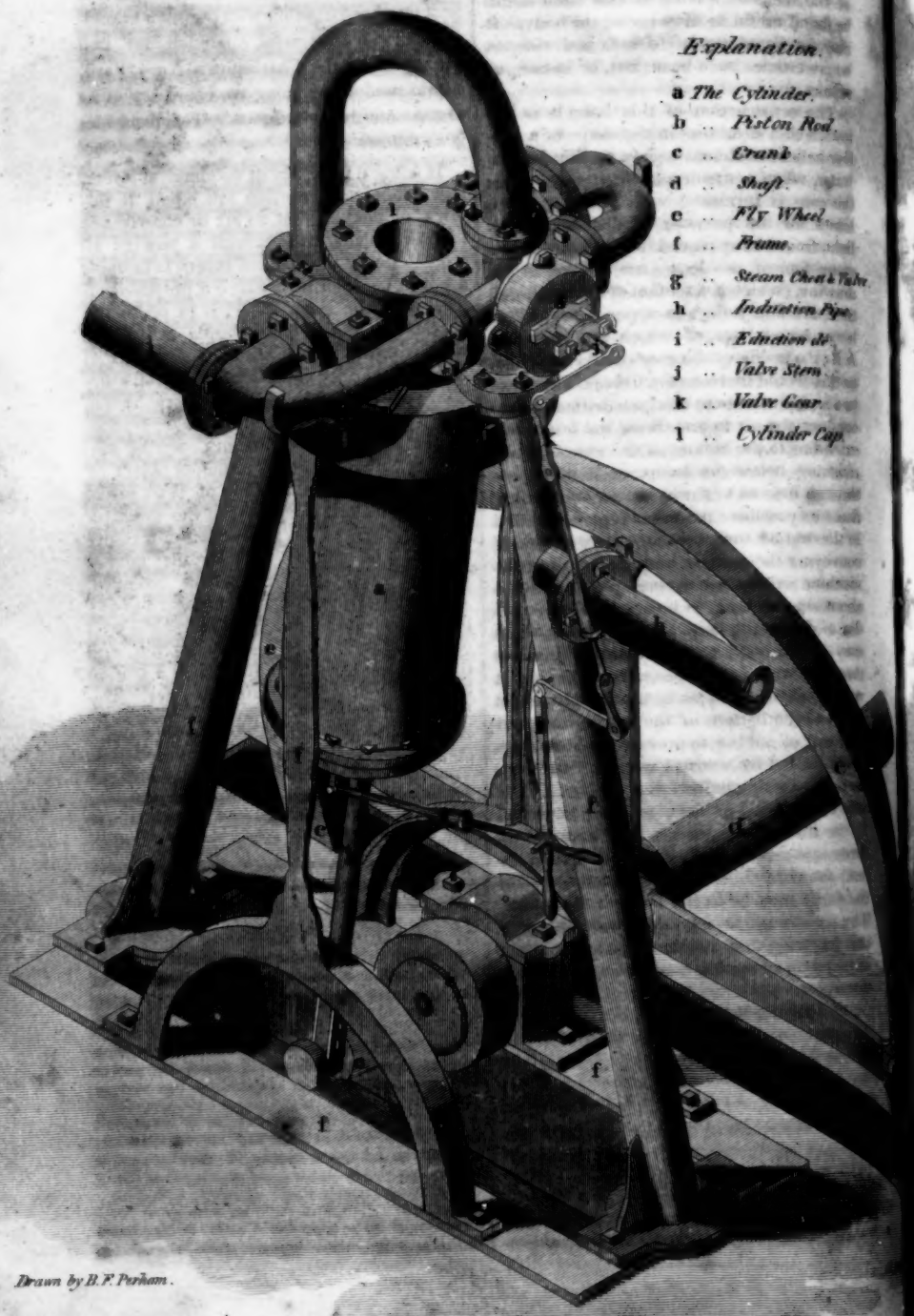
LAMP TO BURN UNDER WATER.



Sir,—If you think this worthy a place in your Magazine, it is at your service. I call it a *Lamp to burn under water*. It was invented and tried by me in 1819, and I found it to answer valuable purposes; for showing articles that are lost in the water, where the tide does not ebb and flow sufficient to discover them without the aid of a diving bell. I think this machine may be used to good advantage in examining the state of vessels bottoms, without being at the trouble of



LESTER'S PENDULUM STEAM ENGINE



Drawn by B. F. Perham.

heaving them down for that purpose. Where persons have been drowned by boat's upsetting, if land marks were taken at the time of the accident, a lamp of this kind might be found useful in discovering the body. It may be found useful in *wells* and *cisterns*, where articles have been lost, or in case of repairs.

The construction of this lamp is as follows, viz. a *metal case* in the shape of a hollow ball, of sufficient weight to sink in sea-water, when its appurtenances are attached; this case is furnished with eight or more lenses for the purpose of distributing the light, from a lamp placed in the centre of the case; four of the lenses are shown in the drawing, (which is a section of the machine;) there are four reflectors opposite to the four lower lenses, two of which are shown at A B; the inside of the case should be white, as this would increase the light. There are two lead pipes, about one inch in diameter, to conduct the air to and from the lamp, one extending to the bottom of the case and terminating below the lamp, or it may pass through it so as to throw the air as near the flame as possible; the other pipe is inserted in the top of the case, for the purpose of conveying the hot air and smoke from the machine; there are several pieces of pipe about six feet long, to be screwed on in order to lower the lamp to any distance that may be wanted; there are three thimbles through which a rope passes, having a weight, C, attached to it, this weight is let down to the bottom of the water, and acts as a sort of anchor, to prevent the lamp from being drifted by a strong current; the rope serves as a guide in lowering the lamp. The size of the ball, or case, must be governed by the focus of the lenses. My lenses were three inches diameter, with a four inch focus; the case eight inches diameter, so that the flame may be in the focus of the lenses. The case must be furnished with an opening for trimming the lamp, with a cover screwed on in such a manner as to keep out the water.

Yours, Respectfully,
THOMAS P. CODMAN.

LESTER'S PENDULUM ENGINE.

We have received a small pamphlet, setting forth the merits of Mr. Lester's engine. As no notice has, heretofore, appeared in our work respecting this clever contrivance, we now cheerfully present it to the publick. The many respectable signatures accompanying this document, (which will be given, with the remainder of the article, in our next number,) together with our own knowledge of its successful operation, for two years past, at the Charlestown Navy Yard, would render any thing we could say in its praise entirely superfluous. The pamphlet is as follows:

It being a fixed law of mechanical forces, that action and reaction are equal, it follows, of course, that no art or contrivance in mechanicks, can *increase* a power: all we can do by mechanical means is to *apply* a power in order to produce a proposed effect; and the great object is to make the application in the most simple and direct way, with the least possible expense of machinery, gearing, complication of construction, resistance from friction or gravitation, and liability to derangement in operation. In the application of steam power by machinery, it has been the principal object of all inventors, from the time of Watt to the present, to direct the power of the steam, in the first place, to the production of a rotary motion, and thence to take the motion adapted to produce the effect intended. The material question then, in regard to any plan of a steam engine, is, whether it is well calculated to produce a rotary motion, and that is the best, which gives such a motion in the most direct and simple manner. The Pendulum Engine is proposed as possessing very important advantages in all the particulars above mentioned.*

* In relation to steam engines, about which so much has of late been said and written, I will here make a suggestion respecting the estimate of the *power* of an engine, in regard to which, there is a great deal of obscurity and uncertainty, both in contracts and in speculations on the subject. In estimating the power of an engine, for instance, as being equal to that of a certain number of horses, only the diameter of the cylinder and length of the stroke are sometimes given, without taking into consideration, the force of the steam and rapidity of motion, with which the engine is calculated to operate; for it is apparent that doubling the rapidity of the motion of the piston, with the same force of steam to the inch constantly acting upon it, will double the power of the engine, as much as doubling the surface of the piston on which the steam acts, supposing it still to act with the same force upon the square inch. It is evident that the largest cylinder, without an adequate supply of steam, will not make a powerful engine; and on the other hand, that a comparatively small cylinder, with a high pressure of steam, and running with great velocity, would make a powerful one. In estimates of this sort, we must, therefore, take into consid-

One advantage of the Pendulum Engine is obvious, not only to a mechanick, but to any person not at all skilled in mechanicks, on the first inspection of the engine, or even a print of one, namely, the application of the power by connecting the piston-rod *immediately* with the crank-pin. Here the lever-beam, connecting-rod, and all the gearing apparatus of whatever kind, interposed between the piston-rod and crank-pin, in fixed engines of all descriptions, is at once dispensed with. The cost of maintaining this gearing is thus avoided. This part of the machinery, in fixed engines, is, as every practical engineer well knows, very liable to get out of order, and the engine must occasionally be stopped to repair it. This inconvenience is also saved by the Pendulum Engine. And, then, this gearing or intermediate machinery, in some fixed engines, as for instance an engine standing on end, and working upwards by a connecting-rod, constantly opposes the motion of the crank, by its gravity, except at the dead points, when the connecting-rod is precisely perpendicular. The resistance from this cause is not great, but whatever it may be, it is saved in the Pendulum Engine. Again, this intermediate gearing is liable to friction, which is a constant impediment that must be overcome by a constant expenditure of power for this purpose. The Pendulum Engine avoids this impediment. By considering how much power would be requisite to keep this intermediate gearing and machinery of a fixed engine in motion, precisely as it moves when the engine is in operation, some estimate may be formed of the saving of power, made in this particular, by the Pendulum Engine. This single advantage of that engine, unless it is offset by some important disadvantage, will, the inventor apprehends, be a sufficient ground for a decided preference of it. But it has other advantages which are conceived to be of much greater importance.

The object being to produce a rotary motion of a crank, it is evident that a fixed engine cannot effect this by a power acting constantly in a right line, for the right line, in such case, is the continuation of that of the piston-rod, and as the crank revolves, the crank-pin, at the end of it, must be out of this line, in all parts of the circle of its revolution, excepting the two points called the *dead points*, at which, in fact, the power ceases to act. So that during all the time when the power acts upon the crank, to give it a revolving motion, it acts at an angle; constantly varying, but still always at an angle. Every practical engineer knows very well, as does also every theoretical mechanick, as well as every man of ordinary observation, though he be neither a practical or theoretical mechanick, that this circumstance must occasion a loss of power, greater or less, according to the angle at which the power thus acts. The lateral reaction upon the piston-rod, occasioned by this circumstance, shows the amount of power that is thus absolutely lost; and this lateral action is so great, that unless the engine and piston-rod are very strongly supported, the piston-rod will be bent or broken, or the engine thrown out of its position. We, therefore, always see the piston-rods of fixed engines very strongly supported at the sides, by slides, or parallel rods, upon which this wasted power is expended. This loss will take place, though the surfaces brought in contact by the lateral horizontal pressure, or pressure perpendicular to the direction of the piston-rod, are perfectly smooth. To illustrate this, suppose the object to be, to raise a ten pound weight six feet; now if it be raised by the hand perpendicularly, without putting it in contact with any other body, it will be necessary only to exert a power equal to ten pounds' weight, with an additional power to produce the motion through the six feet; but if the weight, having a perfectly smooth surface, is applied to a perpendicular plane, the surface of which is also perfectly smooth, and slided six feet up this plane, and if at the same time it is pressed against this plane, an additional force must be exerted equal to the lateral pressure against the plane. And if the surfaces of the weight and perpendicular plane are not perfectly smooth, and no surfaces are so, still an additional power must be exerted in order to overcome the resistance arising from the roughness of the surfaces. Precisely so it is with the lateral horizontal pressure by the cheek pieces of the cross-head against the slides of the fixed engine.

---

eration the extent of the surface of the piston on which the steam acts, the degree of pressure of the steam to the square inch, and the rapidity of the motion of the piston.

It is a popular error, also, not to distinguish sufficiently the engine from the boiler or generator, which is, in fact, as distinct from the engine, as the strength of the mechanick is from the tool with which he works. It may, therefore, not be superfluous to apprise persons, not conversant with steam-enginery, that the remarks made above, on the Pendulum Engine, apply to the engine as distinct from the boiler or generator.

A power equal to this pressure, and an additional power for overcoming the resistance from the roughness of surfaces, is absolutely lost. This loss is entirely avoided in the Pendulum Engine. In comparison with a fixed engine, of which the connecting-rod is three times the length of the crank, (which has been considered by machinists a safe proportion of these parts,) the saving of power made merely by its direct application in the Pendulum Engine, is 16 2-3 per cent. When a longer connecting-rod is used for the fixed engine, the difference will be less. The connecting-rod and crank are, however, very frequently about in the above proportion in fixed engines. This saving is a matter of demonstration by the easy and ordinary process of the resolution of a force, indirectly applied, into the two parts—that which is lost, and that which takes effect. For this superiority of the Pendulum Engine, therefore, I have only to refer to lines and figures and a familiar principle in mechanicks.

In connexion with this subject of friction, another circumstance in the construction and operation of the Pendulum Engine, ought not to be omitted; the importance of which struck me still more forcibly than before, on the examination of the certificates annexed. Every body knows that the piston, within the cylinder, and the piston-rod at the cylinder head, must be packed perfectly tight, to prevent the escape of the steam. In fixed engines, the piston-rod must be braced and supported by a cross-head and slides, or parallel rods, in order to prevent the lateral reaction, from bending or breaking the piston-rod, or throwing the engine out of place. The piston-rod then must be fixed, exactly and firmly, at three points, namely at the piston or lower end, at the upper end, and at the head of the cylinder. Now it will be very obvious that, if these points do not perfectly correspond, and if the piston-rod and the slides by which it is supported on each side, are not perfectly straight and true through all the length of the stroke, an extra friction must take place, greater or less, according to the degree of the irregularity. It needs no experience in steam engines, to know how exceedingly difficult, and, I may perhaps say, absolutely impossible, it is, to adjust these points perfectly to each other; a perfect adjustment of them in all positions of the piston, would require at least as great precision and perfection of workmanship, as are requisite in the most nicely constructed mathematical instruments. And if they are perfectly adjusted to-day, a slight wearing by friction, or a slight jar of the foundation, may derange them to-morrow. By observing a fixed engine, when in operation, a greater or less lateral motion of the cylinder, alternately one way and the other, may usually be observed at every stroke. This shows that these three points at which the rod is fixed and supported, are not perfectly true, and do not perfectly correspond through the whole length of the stroke. A greater or less amount of power must, therefore, be expended and lost, in heaving the whole weight of the fixed cylinder, and all the strong and heavy fixtures connected with it, to and fro, and in overcoming the extra friction thereby occasioned. The piston-rod acts as a lever, bearing against one side of the stuffing box, at the cylinder-head, and the piston will be pressed with an equal, greater, and lesser force, in its different positions, against the cylinder on the opposite side. This imperfection and waste of power would of course appear in the wearing and injury of the packing of the piston-rod and piston, at those parts upon which the lever is acting, and the packing must therefore be renewed so much the more frequently. The condition of the packing and the frequency of its requiring to be renewed, are accordingly one important test of the power lost in this extra friction, and in heaving the cylinder and heavy fixtures towards one side and the other, alternately, at every stroke. This test demonstrates the superiority of the Pendulum Engine in this respect; for, by the annexed certificates, it appears that the packing of fixed engines requires to be renewed at least four times as often as that of the Pendulum Engine. The importance of this circumstance I leave to the consideration of engineers.

Another advantage of the Pendulum Engine, is, that in the motion given to it, in operation, the weight assists in passing the dead points, that is, the two points at which the crank is parallel with the piston-rod. I do not know of any engine upon any other plan, which, by its own intrinsick motion and operation, assists itself over these points, by the mere action of gravity. On the contrary, in engines of a different construction, gravity, as far as it acts at all, more frequently acts as an impediment to the operation of the engine.

In the Pendulum Engine, the whole weight of the cylinder, piston, and piston-rod are kept in motion, and on the first

glance at the machine, the idea has occurred to some machinists, that considerable power must be expended in keeping this weight in motion, and thus lost. They confound the principle of the construction of this engine with that of one suspended in the middle, so as to balance itself, which has mostly gone out of use, and the objections to which will, I think, serve to illustrate the advantages of the Pendulum Engine in regard to the action of gravity. The balanced engine, when put in motion, like all other bodies in this respect, has a tendency to continue the motion, and the greater the velocity is, the greater will be this tendency. Accordingly, when it comes to the extreme position, by the motion of the crank, the momentum it has acquired, tends to an entire revolution of the cylinder, in opposition to the movement of the crank, and the result of these two contending powers of steam and gravity, is the bending or breaking of the piston-rod.

It will, as it appears to me, be obvious, upon the slightest consideration, that the Pendulum Engine is not theoretically liable to any such difficulty, and that it is not practically so, is, I think, very satisfactorily proved by the annexed certificates. As a pendulum of about 39 1-8 inches vibrates seconds, a Pendulum Engine of which, with the piston and piston-rod, the centre of oscillation is at a distance of 39 1-8 inches from the centre of motion, that is, the centre of the gudgeons, will, when put in motion, tend, by the force of gravity, to vibrate seconds; and that, whether the arc in which it vibrates be a greater or smaller part of a circle—if we throw out of consideration, as we will for the present purpose, the difference between the vibrations of a pendulum in the arc of a circle and in a cycloid—and it will continue to vibrate seconds, if power enough is applied merely to overcome the friction on the gudgeons, and the resistance of the atmosphere, which latter may be thrown entirely out of the question. As to the friction on the gudgeons and at the joints of the steam-pipe, it is only a substitute for that of the joints of the connecting-rod of a fixed engine and is much less than that; for I find by experience that there is very little wear at the gudgeons of the Pendulum Engine, which will run a long time before the boxes need to be screwed up, whereas the joints of the connecting-rod of a fixed engine, are subject to great wear, and require to be frequently adjusted. I am at least safe in assuming that the friction at the gudgeons and joints of the steam-pipe, in the Pendulum Engine, is not greater than that of the joints of the connecting rod of a fixed engine; and since the former is a substitute for the latter, there is at least no loss in this respect in the Pendulum Engine. For the present purpose, then, we will assume this friction of the two species of engines to be exactly equal, and throw it out of the question in making the comparison between the two, in relation to the effect of the gravity of the cylinder and piston and piston-rod on the operation of the Pendulum Engine. In regard to gravity, the cylinder of the Pendulum Engine will represent a pendulum of a little less than two-thirds of the length of the cylinder of the engine, so that a Pendulum Engine, of which the cylinder is four and a half feet in length, will, as far as gravity and oscillation are concerned, represent a pendulum of 30 to 36 inches in length. As such a pendulum vibrates seconds, it follows that an engine of which the cylinder is four feet and a half in length, will perform 30 to 35 revolutions in a minute, without the least disturbance or impediment from its gravity; and an engine, of which the cylinder is twenty-seven inches in length, will perform some where about 50 or 60 revolutions a minute, without any obstruction from this cause. To this degree there can be no question that gravity concurs perfectly with the motion of the cylinder of the Pendulum Engine. But it appears from the facts stated in relation to the engines already in operation, that it may be run at double this velocity at least, to advantage. The engineer of the Pendulum Engine at the Navy Yard in Charlestown, from observing the action of the engine, estimates that it might be advantageously driven a hundred revolutions a minute.—This allows of a greater velocity than that at which a fixed engine can be driven without endangering its gearing.*

* The circumstance that the Pendulum Engine, by dispensing with the gearing of the fixed engine, admits of a much greater rapidity of motion, may be of great importance, if it should be established, that the weight and surfaces being given, the friction will be as the *time* without regard to velocity, since in such case, the greater the velocity, the less will be the proportional loss by friction. I am inclined to think that this is a law of friction, and I suspect it is the result of this law which attracted the attention of Mr. Herepath, of England, in his report on locomotive engines, recently republished in the Boston Daily Advertiser, and which he considers as connected with a new theory in mechanical philosophy.

It is then one of the advantages of the Pendulum Engine, within the ordinary proportions of length and diameter of cylinder, that, by dispensing with gearing, it admits of being run with greater velocity than a fixed engine of similar proportions, and the influence of gravity, instead of hindering, rather favors its being driven with such greater velocity.

But the other advantage arising from the influence of gravity upon the action of the Pendulum Engine in helping the crank over the dead points, will be considered by many persons as more important. This influence of gravity, which is constantly maintained by nature and costs no fuel, gives the greatest momentum at the two dead points of the circle of the crank, precisely where it is wanted, and it affords this assistance without any loss or sacrifice, at any other points, for this purpose; being an assistance spontaneously arising from the intrinsick principles of the operation of the machine.

Considering the concurrence of the action of gravity with the motion of the cylinder, I think it will follow, that the largest engine may be constructed on the pendulum principle, without the slightest obstruction from its gravity.

Every circumstance in the effect of gravity accords with, and facilitates, the operation of the Pendulum Engine. Thus if the revolutions of the shaft, and consequently the balance wheel and crank-pin, are perfectly uniform and regular, the cylinder must swing quicker, when the crank-pin is in the upper part of the circle described by it, because the distance from the centre of motion, that is, from the gudgeons, to the crank-pin, is then shorter (the distance which the crank-pin traverses in its circle, from one extreme of the vibration of the cylinder to the other, being less,) than when the crank-pin is in the lower part of its circle, and the cylinder is making its vibrations between the same extremes in that part.—In order to accommodate the influence of gravity to this circumstance, the pendulum should be shorter, when the crank-pin is in the upper part of its circle. Now this is precisely the fact, for when the crank-pin is in the upper part of its circle, the piston, and piston-rod are withdrawn towards the upper part of the cylinder, and thus the weight, being drawn up towards the centre of motion in this part of the revolution, gives a shorter pendulum, and thus adapts the action of gravity more exactly to the regular motion of the crank.

A perfect coincidence in the motion of the pendulum and crank-pin, occurs in one other respect. The pendulum moves slowest towards the extremes of its vibrations; and the *horizontal* motion of the crank-pin across the circle described by it, supposing the crank to revolve uniformly, precisely corresponds to this motion of the pendulum: that is, if a perpendicular line be drawn through the crank-pin, and move with it, this line, as the crank moves uniformly in its circle, will pass over its horizontal diameter at each vibration, that is, twice in each revolution of the crank, and it will pass more rapidly over the part near the centre and more slowly over the extreme parts. Thus we see that the action of gravity in the vibration of the pendulum, and the motions of the crank-pin in the uniform revolution of the crank, accord and harmonize with each other in all particulars.—From these causes arise that beauty and facility in the motion of this machine, which have been remarked upon by many persons who have witnessed its operation.

SAFETY OF STEAM-BOATS.

Professor Silliman prefaces the following article, in his Journal, (written by an able civil engineer, John L. Sullivan, Esq.) with some very pertinent remarks. They are too long to be given, at this time, to our readers. We think, with him, that no practicable means of defending our fellow creatures from the most awful and afflictive casualty should be neglected. He proposes that the government of the United States should offer a munificent reward for the discovery of an absolute preventive of explosion, or an absolute security against its effects. Our extract says:

The engineer (commonly so called) is not perhaps the person to whose negligence the calamity of an explosion should be chargeable, but rather to the fireman; who, besides throwing in the fuel, has to see, by the guage cocks, that the water is kept adequately supplied. This station is extremely arduous, and he is to an unusual degree exposed to the temptation of drinking inordinately. The boiler is usually made of large diameter, and with an inside flue, which is intended to be always covered by the water. This is not the strongest form in which a boiler can be made, but is that which takes up the least room. This flue may, not only from inattention of the fire-

man, but from any accidental obstruction or disorder of the supply pump, get uncovered, or the water low, when it will become red hot, soft, flexible, thin, and weak; and as this part of the boiler is out of sight, this may happen (to a degree short of giving way) frequently in the course of a season: and although the proper quantity of water may be presently regained, still the hidden weakness thus caused remains, and may show itself fatally at some subsequent period. If it were asked, how is the thickness of a boiler in all its parts, after being some length of time in use, ascertained to be sufficient? The usual method is to strike it with a hammer, wherever accessible, trusting to the indications given by the sound of the blow. In the making of boilers, it is possible that the plates may have flaws not quite obvious enough for their rejection, and it is not uncommon for rivets to break by the expansion of the metal, if not made of very good iron. Boilers may be kept in use too long, when the business is not very profitable. It is an expensive job to displace them for repairs, and it is natural to defer it as long as may be safe. Steam boats are sometimes sold at auction, to close a concern, when although the age of the boiler may be told, its condition cannot be so easily known.

It is commonly supposed that the safety valve is an effectual safeguard; and it is so, in a well made and well managed engine. The intention of it is to allow the steam to vent itself when it gets so strong as to lift the weight hung upon the lever of the valve. But it has been known to be fatally overloaded. Besides it is not calculated to give passage to a great and sudden increase of steam. And such sudden and great increase may happen when the flue has been long enough bare to get red hot, and water is suddenly restored in sufficient quantity to receive its accumulated heat. It is well known that water boils at 212° of Fahrenheit. But it is not so generally known that after this degree of heat, every additional 30 degrees, doubles and redoubles the expansive force of the steam, and that it requires very much less fuel and time to produce this 30 degrees more heat, than to produce the preceding 212°.

As explosions have not been confined to high pressure engines, and as the effects have been so tremendous, it has been supposed that the red hot iron of the flue must sometimes decompose a portion of water into its constituent gases, (hydrogen and oxygen.) But it does not seem to be necessary to resort to this supposition to account for the effects, if we consider the amount of the force suddenly liberated by the disruption of the boiler. It must be equal to the outward pressure on a square inch of the safety valve, perhaps never less than 20 lbs., multiplied by every square inch of the internal surface. The displacement of the boiler with such surprising violence may be accounted for from the recoil or reaction of the force from the first considerable resistance it meets with; as well as by the expansive force in the direction it takes. Thus when the Hoboken boat exploded, I am told the boiler was thrown upwards—the rupture being at the under side. That of the Helen McGregor being towards the stern, the boiler went over board through the bow of the boat. Had the forward end burst, it might have been thrown as far as the cabin. The boat may be so injured as to immediately sink—the force driving some part of the machine through the bottom or side; or the shock may start the planking. In two instances the boat has sunk. The danger of this must be greater when the boilers are below, than when on deck.

Every one will admit that it will be for the interest of owners, masters, and men, to take the utmost care. But the danger is inherent in the nature of the power, and it is greater than that from negligence. One fact alone proves this: that the safety valve has not been a sufficient protection in either of the melancholy instances of explosion that have taken place. What is the inference? It must be that the boiler, though up to that time strong, has some how become too weak to bear an expansive force below what it was intended to contain; or else that some how that force has become suddenly so great that the safety valve cannot give vent to the steam.

If then there can be no perfect assurance of safety in steam boats, and so far as depends on fidelity and judgment, much confidence must be reposed in individual laborers, there can be no safety but in keeping out of the reach of the explosion, should it happen; but this can hardly be done, if in the same boat. My opinion, long since formed, and the occurrence of so many accidents—the increase of travel, and the number of steam boats employed, and the circumstance of their growing old, like other machines and vessels, prompt me to remind you of your being, some years ago, on an arbitration between the late Mr. Ful-

ton and myself, to settle the question which of us had first originated the improvement in steam navigation, of separating the load from the power—the passengers from the danger. Had the award been in his favor, this method would probably have been then carried into practice; but being in mine, the exclusive privilege granted by the state to the North River Company, prevented. Yet I have the satisfaction of knowing it had the approbation of that distinguished leader in the art of steam navigation, and I now with pleasure see it in successful use for commercial transportation on the Hudson. But the attempt to carry it into effect for passengers, made with the steam boat Commerce, two years ago, was too feeble; she having no more power than is usual in boats of her class for their own impulsion.

The original design was to appropriate and devote the *leading* boat to the power, and to employ more than is usual for one boat; ample room on board permitting this conveniently, and of using the strongest form of boiler. The *follower* is attached to the leading boat, at a suitable distance, and in a manner that allows of steady motion; and being of a light, sharp construction, with one deck, the resistance of the water and air will be but small; indeed it is the most favorable plan for great speed. It is yoking the gigantick powers of steam to a floating car, and driving them fearlessly along the liquid plain. There is also economy in this plan of operation. Fuel is the heaviest item of expense. The use of *anthracite coal* in steam engines, is a desirable improvement in their management. Hitherto, the difficulty was in augmenting and diminishing this kind of fire at pleasure, in boats. It required a peculiar form of furnace. I mention it because it will afford a sufficient degree of protection against excessive competition, should the state of publick feeling positively require, in future, this perfectly safe conveyance.

It is not probable that the memory of the late accidents will pass away as others have, with only a transient impression of their horrors. The danger has at length come near. Every boat to and from this city bears the connexions and friends of some of us. Were it simply a question of benevolence, or of some publick improvement, it would be carried by acclamation. But there is one difficulty in the way. It is *considered a branch of business*, in which the publick has no more concern than in stages. It is left to the enterprising in its line, and all trust that competition will produce perfection, as well as cheapness. And it might be left to ordinary competition, were it not a question of life. It is, in this respect, quite different from all other branches of business. It is a concern belonging to the publick, as well as to the owners of the boats, and yet its defects and dangers are not of a nature to be prevented or guarded against by any law. Nothing but a determination of the community to have and sustain safe steam conveyance, will avail.

This branch of enterprise has taken the form of rivalry, in splendor and rapidity, and these admirable qualities will still command an ample share of business. But, however admirable, they do not compensate for the risk of life. Why should not the publick be also entirely satisfied on this point, and have the choice, at least, of safety. This improvement remains to be made, and superadded. Knowing its practicability, and the excellent accommodation of which this method is capable, it seems incumbent, at this time, thus to bring it into view. If its suggestion meets with approbation, a company may, perhaps, be formed, with sufficient capital for two equipments, one to proceed every day from New York to Albany. The passage may in this manner be accomplished, it is thought, in ten hours.

As travel is always increasing between these cities, and as a rational preference would be given to a commodious yotte, (yatch) drawn swiftly and steadily along, there seems to be some reason to expect the concern would be profitable. But the prevailing opinion may be, that it cannot be said to be certainly an object of speculation, or a source of profit. Perhaps the undertaking must rest alone on the basis of philanthropy and publick spirit. If, then, on this ground, the prevailing sentiment of the community is favorable, perhaps it will be manifested by an ample capital, subcribed in moderate sums, especially should it meet the approbation of those who assemble daily at the banks and publick offices, and to administer the city government. It is a measure of self-defence.

Vegetable Extract.—In the north of France an excellent extract of the herbs used in soups and broths is made by boiling them very slowly with a sufficient quantity of salt and afterwards evaporating the fluid. A little of this extract, dissolved with gum arabick in hot water, is said to make capital soup.

Fig. 1.

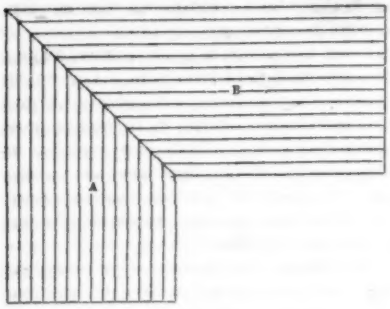


Fig. 2.

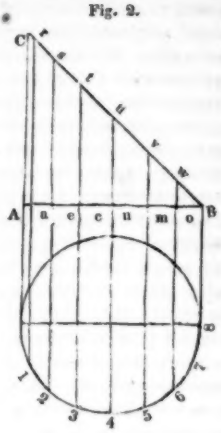


Fig. 3.

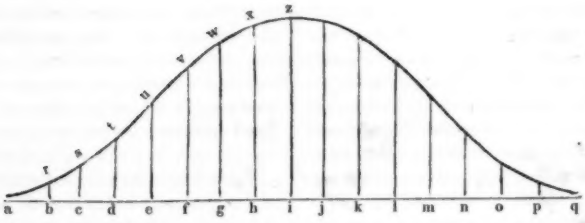


Fig. 4.

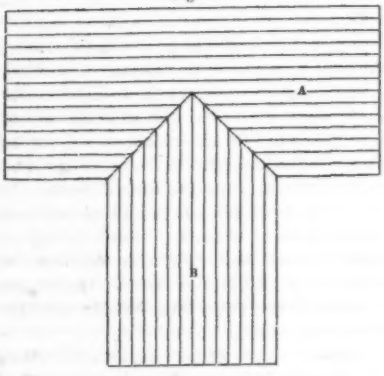


Fig. 5.

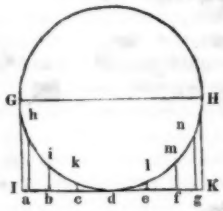


Fig. 7.

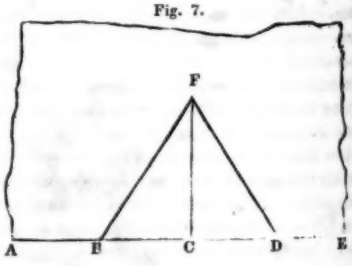
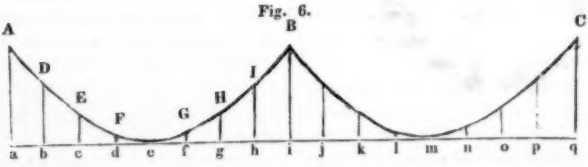


Fig. 6.



COMMUNICATION.] [FOR THE MAGAZINE.

METHOD OF OBTAINING THE ANGLE OF STOVE PIPE.

Mr. Editor,—In conversation with one of your correspondents a few days since, I learnt that mechanicks in general had no particular rules for drawing the curves made by the surfaces of hollow cylinders cut diagonally and developed on a plane. It is evident that plain and simple rules would be highly beneficial to the manufacturers of stove funnel, and all those who have occasion to join pipes, by what is technically called elbow joints, &c. I also learnt that the common method was to dip the pipe into water, taking care to hold it at half the required angle, which the pipes were to make with each other. The surface of the water would then indicate the curve. As this is a very unsafe way of proceeding, I have sent you the following, which may be of service to some of your subscribers.

Fig. 1 represents two pipes at right angles to each other, and the most common joint that occurs in making stove funnel. To find the curve which the surface of either of the pipes A or B will form, when bent down on a plane, we must first describe a circle, the diameter of which is equal to the diameter of the pipe. Divide the circumference into any number of equal parts, 16 for instance. The semicircumference will contain 8 of these parts. Then at any convenient distance from the circle, let a line AB, be drawn parallel, and equal to the diameter, so that its centre shall be in a line perpendicular to the diameter, and passing through the centre of the circle. Let the line CB make an angle with the line AB, equal to half the angle which the pipes make with each other. Through the points of division, 1, 2, 3, 4, &c. draw lines, 1 a r, 2 c s, 3 c t, &c. perpendicular to AB. Let another line, a q, Fig. 3, be taken equal to 3¼* times the diameter. This line will be equal to the circumference of the circle. Divide it into 16 equal parts. From each of the points a, b, c, &c. raise perpendiculars, to the line a q. Set off the distances A c, a r, e s, c t, &c. upon the lines i z, h x, g w, &c. The points a, r, s, t, u, &c. will be situated in the curve sought. Then if we connect these points by lines, correcting all irregularities by the eye, it will be near enough for all practical purposes.

If we wish to find the curve which will be generated by the edge of the pipe B in Fig. 4, a different construction from the former will be necessary.

Describe a circle, Fig. 5, equal in diameter to the diameter of the pipe. Divide the circumference into any number of equal parts, and draw through these points, lines perpendicular to I K, which is parallel to G H. Then on a straight line, take a distance aq, equal, 3¼ times the diameter G H. Divide the line a q into the same number of equal parts, as you have divided the circumference of the circle. From each of these points raise perpendiculars, and set off on these lines, the distances G I, h a, i b, from A a to B i. Proceed as in the first instance, and A a D E F e G H I B m C will be the required curve. All that is necessary for the construction of the pipe A, is shown in Fig. 7, and which may be easily understood from the same, remembering that C F = ¼ of the circumference, and B D = diameter of the pipe.

**

* The true ratio between the circumference of a circle and its diameter = 3,141926, but 3 1-7 times the diameter is near enough in practice.

Specifications of American Patents.—*Specification of a patent for an improvement in the mode of laying the foundation of Marine Rail-ways under water. Granted to James Ronaldson and John Lindsay Neill, of the City of Philadelphia, May* 22, 1830.

Our said invention is particularly intended for marine rail-ways in places where, from the nature of the bottom of a river, or other water, on which it is to be established, piles cannot be securely driven, or where the expense of driving them, and of erecting the required structure upon them, would form a serious objection thereto.

It is also applicable in all situations where the bottom is of a hard substance, and is equally efficacious with a foundation of piles, and can be carried into operation in many instances with much greater facility, and less expense.

A proper survey of the bottom upon which the rail-way is to be erected, must first be made, in order to ascertain the proper shape, or curvature, which should be given to the under part of the frame work, of which the foundation and rail-way, below the water, are to consist. This frame may be made and braced together in various ways, the sills being so formed as to adapt themselves to the bottom, and the upper part, or rails, having such an inclination as may be considered best for the intended purpose.

In forming the *Philadelphia Marine Rail-*

way, the work was put together over the place where it was to be used, but it may be formed or framed elsewhere, and transferred to its place of destination. The framing was commenced by fixing a number of beams strong enough to sustain the intended superstructure, and in such relative positions as that a line crossing them would have the same curvature with the bottom of the river, which is to be the foundation. Upon these beams were laid three sets of sills parallel to each other, the centre sill being situated under the keel rail, and the two side ones under the bilge rails. The sills were united together by logs forming cross-ties; and into the upper sides of the sills were inserted posts to support the rails. These posts were tenoned into the sills sufficiently deep to admit of a trenail. The whole of the sills, rails, and posts, being strongly braced by timber framed into them diagonally and otherwise, to give them the required strength, iron bolts, dovels, and trenails, were also driven when they were deemed useful. The scarps of the rails, or wooden ways, were all doveled and bolted, and made to rest on the posts: the ways were likewise doveled to each cross-tie, besides bolting. The upper sides of the rails, or wooden ways, were made perfectly even, and the iron rails then securely bolted upon them.

The manner in which this framing was effected, is represented in the drawing, and also in a model deposited in the patent office; they are deposited in compliance with the law, which requires that drawings, with written references, be furnished; and they serve to exhibit in a practical way, how the invention has been carried into effect.

The frame when completed is to be sunk into its place. Before this is done, the bottom upon which it is to stand, must, if covered by any loose substance, be scraped, so as to remove whatever might interfere with its adapting itself thereto. The mode which we adopted for sinking the frame, was, first to lay a floor upon the cross logs, or ties, and fasten plank to the sides. These planks were to keep in the stones, or material used to sink the frame. The supporting beams were then removed, and the whole frame let down by tackles that held it suspended when the cross bearings were taken out. To save the trouble and expense of procuring large stones, small ones were put into barrels and headed up, in order to retain them in the situations where they were required. The frame was thus sunk into its place, and loose stones, earth, and sand, thrown into, and around the whole.

We claim as our invention, the mode in which the above frame was put together; and we claim as new, and as our invention, this method of making the foundations, and the fixing of marine rail-ways under water, without the driving of piles, the making of coffer dams, the using of diving bells, or any similar structures, as usually employed for that purpose.

If the rail-way is intended for large vessels, the having *five* rail-ways, viz. one under the keel, one under each bilge, and one on each side for the support of the upper works of the vessel with shores, are all considered modifications of the principle herein described, and we accordingly claim this method also as our invention.

JAMES RONALDSON.
JOHN L. NEILL.

Specification of a patent for a machine for Lifting Ships or Vessels out of the Water. Granted to William Ballard, of New-York, as assignee of the inventor, Thomas Evans, of the City of New-York, May 28, 1830.

The invention above mentioned consists in the application or substitution of cylinders with floating pistons in them in place of screws, or other machinery, in the vertical lift docks now in use. These cylinders with their pistons are constructed in precisely the same manner as what is known and called Bramah's hydrostatick, or water press, and are applied to the lifting of ships in the following manner, to wit; such a number of piles are driven in the river, as to form two piers at such distance apart as to allow a ship to be floated in between them; those piles which form the inner row of those piers, are driven at regular distances asunder, and are firmly secured together by large pieces of timber called plate pieces, running the whole length of the dock, on each side, level, or even with the surface, or decks of the piers. Between these piles, and from said plates, are suspended a row of cast iron cylinders at equal distances apart, and directly opposite each other, on either side of the dock. Each of these cylinders are furnished with a solid iron piston, sliding through a stuffing box in the head of the cylinder; each piston has a cross head, fitted on its upper end, reaching to square posts framed into the plate, half way between the cylinders. These posts form guides for the cross heads, causing them and the piston to which they

are connected, to move perpendicularly to the cylinders. From the cross heads iron bars are suspended on either side of each piston, reaching down through the plates to the trussed beams, or girders, which form the cradle for supporting the ship. These bars pass through the ends of the beams aforesaid, and are strongly secured to them by iron keys passed through the bars on the under side of the beams. These beams are made of great strength by a peculiar method of trussing them; they reach the whole width of the dock, two to each pair of cylinders forming a section; a number of sections forming the cradle; the length, breadth and strength of which will depend on the size of the ship to be lifted. Each section moves independent of the rest, and can be raised or lowered at pleasure. The cylinders are connected together on each side of the dock by a pipe running the whole length thereof. In these pipes, between each cylinder, there is a stop cock, shutting off the communication between them when necessary. One or more pumps are attached to these pipes for the purpose of forcing water into the cylinders for raising the ship. Other stop cocks are provided for letting the water out of the cylinders when the ship is to be lowered.

Operation.—The water being let out of the cylinders by turning the cocks aforesaid, the pistons by their weight settle down in the cylinders, carrying the cradle along with them; and when the pistons are wholly within, the cradle is sunk low enough beneath the surface of the water to allow the ship to be floated in between the piers, and over the cradle; she being moored in the centre between said piers, her keel is directly over the keel blocks. The pumps being now set at work, the cradle is raised till the sections have all found their bearings. The bilge wedges are now hove up to steady the ship in her position. She is now lifted some distance further, when being safely shored, she is by the continued action of the pumps safely and expeditiously lifted out of the water.

The lowering of the ship is a work of great simplicity; a number of escape cocks on each side of the dock are opened and she descends by her own weight with a steady, constant motion, till she finds her bearing in the water.

Now I wish to be understood that what I claim as new and my invention, is the application of what is called the hydrostatick principle of forcing water into cylinders, after the manner of what is known as Bramah's press; the raising of the pistons by the injection of water into the cylinders in which they are inserted, being applied to lifting the ship in the manner described above. And further, be it known that I do not confine myself to the particular manner of application as described above; that only appearing the most convenient at present. —*Franklin Institute.* T. Evans.

PREMATURE EXPLOSIONS.

Account of a premature explosion of gunpowder in blasting of rocks, by Dr. Comstock, who was called in attendance upon two men who were severely injured while preparing to blast; dated Lebanon, Ct. Nov. 9, 1829.

On the first day of June, 1825, my professional attendance upon two men at Bozrah Ville, was requested in consequence of the premature ignition of the charge in a rock which they were preparing to blast.

Upon a minute inquiry respecting the origin of the fire, I became convinced that it could not have arisen from any collision between metal and stone, as the wire was copper. At the instant of the explosion one of these men was in the act of striking down the covering of the charge with a sledge weighing fifteen pounds, and I am disposed to think that the fire in this, and perhaps in other cases of premature ignition, originated from the compression of the air in the hole of the rock. Any one who has seen the little instrument called a *fire pump*, and who has seen fire obtained by a stroke of the hand upon its piston, cannot be a moment at a loss to account for the origin of the fire in this and in similar instances, depending upon the condensation of atmospherick air, and the friction of the piston evolving heat or electricity, or probably both. It appears to me scarcely to admit of doubt, that this is the true cause, and this opinion is fortified by the fact that an explosion of powder both in muskets and in artillery sometimes happens whilst the charge is ramming down, and the origin of the fire has often been considered as unaccountable. But if the touch hole is stopped air tight by the powder, the gun with the ramrod is then converted into a complete *fire pump*. The vent of artillery should never be closed whilst the charge is ramming down, as is sometimes done by the finger of an assistant, and the pans of muskets and pistols should always be left open; yet, after all, if the chamber of a gun is rendered air tight

by the stoppage of the vent by the powder, it is easy to conceive that by the ramrod and wadding the gun may at once be converted into a fire pump, and that, by a violent thrust of the ramrod, fire may be generated between the wad and powder. The only safe course is, therefore, not to use very great force in driving down a charge; and to keep the head and body averted from the mouth of the piece.

But in relation to blasting rocks, the most proper substance for confining powder, is a plug of green wood with either a hole through it, or a small semicircular excavation in one side of its whole length which may be filled with powder, and fired after the plug is driven in. It is apparent that the hole or excavation in the plug will prevent the compression of the air; and that, while dry wood might be suspected of exciting the electrick spark by friction against the sides of the hole in the rock whilst driving it forcibly down, that green wood will not have that effect. Since the above accident I have, in a few instances, seen this method tried successfully by my own advice.

March 24, 1830.—The principle of the *fire pump*, (so far as I am informed,) not having been considered in its application to forcing down the wadding or covering of powder in a rock, I am induced to call your attention to the fact that it is often done, with great force and violence; as was the case in the instance at Bozrah Ville. The two workmen, who were there blown up, were alternately employed in striking down the covering, which was of pounded brick, on to the powder with a sledge weighing fifteen pounds!

The method adopted by your correspondent of covering the charge of powder with a wooden cone, and filling the interstice with sand, steers clear of the principle of the *fire pump*, and is perhaps the best method yet discovered.—(Silliman's Journal.)

Cement from Iron Filings.—M. Mailtre having reflected upon the action of vinegar in the preparation of the cement known as *mastick* le limaille, which is made of iron filings, garlick and vinegar, so proportioned as to form a mass of moderate consistency, proposed to substitute for the vinegar sulphurick acid diluted with water, in the proportion of one ounce to a little more than two pints of water, and to reject the garlick as useless. This alteration was soon adopted by all to whom he communicated it in Paris, and will save in Paris alone more than ten thousand francs annually. This cement is there employed to close the seams of the stones with which terraces are covered. The iron filings becoming oxidized, occupy a larger space, their oxidation being facilitated by the action of the acid, and the joints become exactly closed.—(ib.)

Concentration of Sound.—It happened, says Dr. Arnott, once on board a ship sailing along the coast of Brazil, far out of sight of land, that the persons walking on deck, when passing a particular spot, always heard very distinctly the sound of bells, varying as in human rejoicings. All on board came to listen, and were convinced; but the phenomenon was most mysterious. Months afterwards it was ascertained, that, at the time of observation, the bells of the city of St. Salvador, on the Brazilian coast, had been ringing on the occasion of a festival; their sound therefore favored by a gentle wind, had travelled perhaps one hundred miles by smooth water, and had been brought to a focus by the sail on the particular situation or deep where it was listened to. It appears from this, that a machine might be constructed, having the same relation to sound, that a telescope has to sight.—(ib.)

Dr. Mitchell's Method of working Caoutchouc.—Soak the gum elastick in sulphurick ether, until soft and nearly inelastick, which in good ether will take from ten to twenty-four hours. Then if it is a plate, cut it with a wet knife or parallel knives, into such sections, or sheets, or shapes, as may be desired, and suffer them to dry; or if a bag, apply a pipe or stop-cock, and inflate with the mouth; if the bag should expand equally, inflate rapidly, but if unequally, proceed more slowly and with occasional pauses. By such means a bag may be made so thin as to become transparent, and light enough to ascend when filled with hydrogen. By graduating the extent of inflation, a sheet of caoutchouc of any given thickness is produced. If for blow-pipes, or other purposes for which it is desirable that the bags should possess contractility, let them be inflated to the desired size, and after an hour let out the air. Ever after they will suffer as great a degree of extension, and again contract. If permanent sheets are wanted, the inflated bags are to be hung up until dry, after which no sensible contraction will ensue.

Bags softened by ether may be stretched readily by the hand, over lasts, hat blocks, or other moulds, so as to assume the shape desired, and may be so applied to a variety of useful purposes. In the form of straps and twisted strings, its elasticity offers many useful applications. It is easily formed into tubes to connect apparatus, &c.

Some of the bags have been extended to six feet in diameter; one of these being filled with hydrogen, escaped, and was found one hundred and thirty miles from the place. A bag, originally the size of an English walnut, was extended until fifteen inches in diameter.

Dr. Mitchell states, that oil of sassafras softens caoutchouc so that it can be applied with a brush, and that upon drying by exposure to air, it becomes again simple elastick caoutchouc. Many applications of it as a varnish, in this state, are suggested.—*Franklin Journal.*

Detection of alloy in silver by the magnetick needle.—Oersted has made an ingenious and novel application of the magnetick multiplier. He finds that if a good electro-magnetick multiplier, with double needles, be suspended by a hair, or a thread of unspun silk, between two pieces of wrought silver, differing only one per cent. in the quantity of copper they contain, so sensible an effect is produced upon the needle as to render this a more accurate method of proof than the common touchstones. Small trial plates are made of different degrees of purity, and the piece to be tried is compared with them in the following way; a thin piece of woollen cloth is dipped in muriatick acid, and laid upon the trial plate, after which the piece to be tried is brought into contact with the acid and the wire of the multiplier. The deviation of the needle shows which contains the most alloy, and another trial plate must be employed till the needle cease to be affected, when both are of equal fineness. In coming to a conclusion on this point, however, several circumstances are to be taken into consideration. Wrought silver goods are generally deprived of a portion of their copper by the action of acids, so as to render the surface finer than the inner part of the metal; the proof plates, therefore, must be prepared in the same way. Another source of error in the indications of the needle are the unequal polish and size of the two pieces of metal; the latter of these is especially difficult to overcome when the surface of the metal to be proved is not plain, when, instead of muriatick acid, a dilute solution of caustick potash is employed, and the result is unlike, it is shown that copper is not the only alloy, but that brass is present; and the potash solution renders that which contains brass so positive, that it seems considerably purer than the trial plate. This is the case also in a very high degree when the alloyed metal contains arsenick, for example, when what is called white metal has been used for an alloy.

This mode of proof is exceedingly interesting, in a scientifick point of view, and cases may occur in which it may be employed with advantage; but the sources of error can scarcely be ever so completely done away with as to make it a practical instrument in the hands of the silversmith, as Oersted seems to expect.—Berzelius, *Arsberattelse*, p. 123.

Alloy for the construction of Cocks and Pumps.—This alloy consists of 4 parts of tin, 4 of zinc, and 1 of antimony; these metals, when fused, and well mixed together, have been found well suited to make good pumps. Cock metal is generally an alloy of lead, zinc and antimony, to which more or less tin is added. The alloy described as good for pumps, is fit for cocks, but one to be mentioned is still better; of the two parts of a cock, namely, the box and the plug, the latter should be rather harder than the former, and therefore contain more antimony. An alloy of 80 parts of tin, with 20 of antimony, is well suited for the plug; and one consisting of 86 parts of tin, and 14 of antimony, for the boxes of cocks.—*Bull Univ.* xiv. 36.

Cements for Iron Water Pipes.—M. Gueymard, in an interesting statement of the introduction of water into the city of Grenoble, says that the mastick which he has employed to connect the pipes, has been known for some years, by the name of *Aquin*. Most of the recipes vary, and those which he had obtained directly from Vienna, Lyons, Paris, and by correspondence from London, do not answer his purpose. For this reason he commenced a series of experiments, and found the following composition, acquired the hardness and compactness of good cast iron.

I mingle ninety-eight parts of cast iron filings (pounded turnings) passed through a coarse sieve, and not oxidized, with one part of flowers of sulphur. When intimately mixed, I take one part of salammoniac, and dissolve it in boiling water; and pour

this solution on the preceding mixture and agitate it thoroughly. The quantity of water ought to be such as to reduce the whole to the consistency of common mortar.

This cement disengages a great quantity of heat and ammonia, and should be immediately used. It is pressed forcibly into the joints, and after drying two or three days in the open air in summer, and from seven to eight days in winter, the pipes may be covered, with an assurance of their solidity.

In all the basins or reservoirs of the city, he used only this cement, and the joints prove to be as tight as if cast iron had been melted and poured into them, or as if the cisterns were made of glass. They stand in no need of repairs.

He recommends this cement in all cases of hewn stone and other solid works exposed to the weather, as in bridges, aqueducts, conduits, &c.—(Annales des Meins.)

American Calicoes.—It is not generally known to the publick that the art of calicoe printing, is now brought as near to perfection in this country, as it is in Europe, and that at the *Eagle Print Works* at Bellville, in New-Jersey, upwards of 4000 pieces, or 120,000 yards are printed weekly. We visited these works a few days since, and were surprised to witness the extent and perfection to which the enterprising proprietors Messrs. Samuel, Wright, and Andrew Gray have brought this branch of business. The works are very extensive and embrace within themselves not only the necessary appendages of printing works, but shops for the manufacture of all the patterns, forms and tools which are required in conducting the establishment.—Upwards of two hundred persons are constantly employed and as we before mentioned finish about 120,000 yards per week. Those who have never witnessed the printing of cottons can form but an imperfect idea of the different processes which they undergo from their first passage over a *red hot cylinder* to their final finish for market.—The perfect accuracy of the machinery used, the rapidity of its execution, added to the beautiful simplicity of its construction, forcibly impress upon the spectator the wonderful ingenuity of man. Our attention was particularly arrested by a machine which printed with two colors at the same time, and with the same rapidity as if one color were used.

We were pleased to learn that the enterprising proprietors of these works find a ready market for all they can finish.

The patterns now in use at the *Eagle Works* are equal to any we have seen, and we doubt not but many a fair one, who imagines she is decked in the "latest importation," is, in fact, arrayed in calico, wove in New-York and printed in New-Jersey.—(N. Y. Enquirer.)

Items from the London Mechanicks Magazine.

Water-Proof Cloth.—For rendering fabricks of hemp, flax, cotten, wool, silk, and various other substances, impervious to water, by the employment of a thick elastick varnish, made by dissolving caoutchouc in a small quantity of coal oil. The proportion of coal oil required to dissolve a given quantity of caoutchouc will vary according to its peculiar quality, as well as that of the resin; but the average quantity required will be about a quarter of a pint of the oil to a pound of the resin. To facilitate the solution, the caoutchouc is to be cut into as thin shreds as possible, and the heat of a steam-bath applied. When the solution is completed, it is to be strained from the residuum.

To apply the varnish thus prepared, the cloth is to be stretched upon frames, and brushed over with it; and the varnished surfaces of two pieces of cloth, while in a sticky, yet tolerably hard, state, are laid one upon the other, and passed between rollers subjected to pressure, which firmly and inseparably unites them.

A flexible and thoroughly water-proof material is thus obtained applicable to a variety of useful purposes, without the inconvenient and unpleasant varnished sticky surface, so common in other water-proof coverings.

Hancock's caoutchouc hose, is prepared in a similar manner.

Volcano.—Letters fron Sicily give lamentable details of the late eruption of Mount Etna. Eight villages, not one of which was ever before affected by the flames or lava of the volcano, have been buried under enormous masses of stones and cinders. The consts of Calabria, and some parts of Italy, exposed to the wind, have been covered with the same red dust as the vicinity of Etna. The country round the volcano has been completely desolated.

Yellow Dye from Potatoes.—A French paper disputes with Sir John Sinclair the honor of having discovered a yellow dye in the potato flower. The discovery is stated to have been made in 1794, by M. Dambourny, a merchant at Rouen, who published a treatise respecting it at the time.

Anatomical Model.—At the sitting of the Paris Academy of Science on the 8th inst., M. Auzon, a physician, exhibited an anatomical model five feet seven inches high, in the position of the Antinous. It is divided into two halves for the convenience of transport, and every part is made to take to pieces, so as to represent the internal arrangement of the human subject. The muscles may be removed layer by layer, until we come to the skeleton. The brain opens, and is divided into slices exhibiting the nerves and all the ramifications. The intestines, diaphragm, lungs, and pericardium are removable; and the heart is divided

into cavities, with red and dark blood. Altogether it is an astonishing production. It cost the artist twelve years of labor before he could complete it; but now he will be able to make others from it at an expense of about 3000 f. for each subject. No cabinet of anatomy, or surgical school, should be without one of these models. Even in France, where the real subject is to be had without difficulty, the members of the academy say that it will be of great service to young students.

Mount Ararat.—From a late number of the St. Petersburgh "Academical Journal," we collected some authentick particulars of Professor Parrot's recent journey to Mount Ararat. After being baffled in repeated attempts, he at length succeeded in overcoming the obstacles which beset him, and ascertained the positive elevation of its peak to be 16,200 Parisian feet; it is, therefore, more than 1500 feet loftier than Mount Blanc, which has been hitherto accounted the sovereign of mountain altitudes in Europe. He describes the summit as being a circular plane, about 160 feet in circumference, joined by a gentle descent, with a second and less elevated one towards the East; the whole of the upper region of the mountain from the height of 12,750 feet (English,) being covered with perpetual ice and snow. He afterwards ascended what is termed "The little Ararat," and reports it to be about 12,300 Parisian feet high (13,100 feet English.)

New Bread.—A Parisian chymist has established a bakehouse for bread made from potatoes, which is animalized by the addition of the gelatine made from bones. In this way a food which is said to be equally pleasant and more nutritious than wheaten bread, is obtained at half the expense of the latter. A large quantity of biscuits, for the use of the African expedition, has been made upon this plan. In a time of scarcity of corn, the discovery will prove a great blessing.

Protraction of Vegetable Life.—The following extraordinary instance of the lengthened period of time during which the vital principle of vegetables may be preserved, was mentioned by Mr. Houlton, in the course of his introductory lecture as professor of botany, at the last meeting of the Medico-Botanical Society:—A bulbous root, which was found in the hand of an Egyptian mummy, in which situation it had very probably been for more than 2000 years, germinated on exposure to the atmoshpere, though, when discovered, it was apparently in a state of perfect dryness. The root was subsequently put into the ground, where it grew with readiness and vigor.

Imitative Gold.—Professor Hermstadt has lately made known the composition of a fictitious gold, which is much in use among the German jewellers. To sixteen parts of pure platina add seven parts of brass and one part of zinc; place them in a crucible, cover the whole over with pulverized charcoal, and keep it over the fire until the composition is in a liquid state, and reduced to one uniform mass. This alloy has not merely the color of gold, but possesses its ductibility and specifick gravity.

Butter.—The *Journal des Connaissances Usuelles* gives an account of the means used in the canton d'Issigny to procure excellent butter in winter. The cows are warmly clothed, so as to cause them to calve in the autumn, as it is found that the milk, after this process of nature at that time, becomes more abundant and richer in quantity; and during the severest weather in the winter, they were constantly kept clothed, and fed in the open air; as the taste of the butter is said to be much injured by confinement in the stable. The butter of this district is superior to any other on the continent.

Dandelion Coffee.—Dr. Harrison of Edinburgh, prefers dandelion coffee to that of Mecca; and many persons all over the Continent prefer a mixture of succory and coffee to coffee alone. Dig up the roots of dandelion, wash them well, but do not scrape them, dry them, cut them into the size of peas, and then roast them in an earthen pot, or coffee-roaster of any kind. The great secret of good coffee is, to have it fresh burnt and fresh ground.

Wine from unripe Grapes.—Dobereiner of Jena, who ranks among the first of German chymists, has latterly been occupied in making experiments on the possibility of ameliorating wine, derived from the juice of unripe grapes; and has discovered, that it may be rendered perfectly sweet, by injecting the powder of bones, which have been reduced to a state of whiteness by combustion.

New Food for Silk Worms.—At a late meeting of the Royal Society at Lille, a letter was read from Clara Girodin, with which that lady transmitted samples of silk, produced in the years 1828 and 1829, from worms which had been fed wholly upon the leaves of the *Scorsonera*. She states that she could never discover any perceptible difference between the produce of worms thus treated, and those which were fed on the leaves of the white mulberry. The same changes and the same diseases affected either of them in an equal degree. M. Bosc also states, that the silk from the worm nourished with the *Scorsonera* leaf, was sold at Lyons for twenty-four francs per pound (or 19s.); within a fraction as high as the silk produced in the South of France. This discovery is highly important to all countries where the mulberry is of precarious growth.

Extract of Pennyroyal.—Farmers might easily save the flesh of horses and cows, and confer great kindness on their animals in preventing the usual annoyance of flies, by simply washing the parts with the extract of pennyroyal.

MASSACHUSETTS CHARITABLE MECHANICK ASSOCIATION.

This Association have their meetings at the Athenæum on Monday evenings, at 7 o'clock. The Introductory was delivered on the evening of the 11th inst. by the Rev. Mr. Frothingham, in a very eloquent and able manner. The second lecture, by the Hon. Edward Everett, on the Monday evening following, was well received. We think, however, he rather *tickled* his audience a little when he brought them all under the broad ægis of the WORKING-MAN'S *party*.

The Association will continue their lectures on the above mentioned evenings through the season,—by the following gentlemen:

Rev. N. L. FROTHINGHAM,
Hon. EDWARD EVERETT,
" ALEXANDER H. EVERETT,
" WILLIAM SULLIVAN,
Doctor JOSHUA B. FLINT,
" J. V. C. SMITH,
" JOHN PARK,
" D. H. STORER,
" C. ROBBINS,
" WILLIAM GRIGG,
" JOHN C. WARREN.

Members of the Association will obtain Tickets of the Secretary, Mr. Joseph Lewis, Ann-St.

BOSTON MECHANICKS INSTITUTION.

The Lectures will commence at the Lecture Room of the Athenæum, on Wednesday evening, November 17th, at 7 o'clock. Franklin Dexter, Esq. will deliver an introductory lecture. The lecturers for the present season are

FRANKLIN DEXTER, Esq.
Professor FARRAR,
Hon. WILLIAM SULLIVAN,
DANIEL TREADWELL, Esq.
Dr. J. C. WARREN, and
Dr. J. W. WEBSTER.

The admission of members is $2,00, and this sum is assessed annually upon the members, for defraying the expenses of the Institution. Minors, of good character, may obtain tickets for admission to the Lectures for $1,00. The Recording Secretary will be found, during the commencement of the season, at the Bookstore of Messrs. Cottons & Barnard, corner of Washington and Franklin streets, on Monday afternoons, from 3 to 5 o'clock, for the purpose of furnishing members, and minors, with tickets.

BOSTON LYCEUM.

This Institution commenced its course for the present season by a publick introductory lecture at the Rev. Mr. Malcom's Church, Federal Street, on Thursday evening, 21st inst. The performance was a plain, practical, common-sense affair; giving an able exposition of the objects of Lyceums, and evinced much original and independent "*thinking*" in the Lecturer.

The following gentlemen will lecture for the ensuing season.

ASA RAND, Introductory.
T. R. MARVIN,
CLEMENT DURGIN,
JOSEPH JENKINS,
F. J. GRUND,
D. T. COIT,
AMASA WALKER,
B. B. EDWARDS,
T. CLAXTON,
M. GAY,
J. A. DAVIS,
R. ANDERSON,
J. ABBOTT,
ENOCH HALE.

Meetings held at Chauncy Hall, every Thursday evening, at 7'clock.

Persons of good moral character by handing their names to the Treasurer, or Secretary, of the Association, and paying two dollars, annually, may become members.—Minors, eighteen years of age, by paying one dollar.

BOSTON SOCIETY FOR THE DIFFUSION OE USEFUL KNOWLEDGE.

The Introductory Lecture of the course will be given on Friday evening, Nov. 5th, by the Hon. Judge Davis.

The lectures will be continued on every Friday evening through the season by the following gentlemen:

Hon. Judge DAVIS,
Rev. Mr. GREENWOOD,
JARED SPARKS, Esq.
JOHN C. GRAY, Esq.
Gen. THEODORE LYMAN,
BENJAMIN A. GOULD, Esq.
Dr. ENOCH HALE,
Dr. J. GREELY STEVENSON,
Hon. JAMES T. AUSTIN,
Mr. Chief Justice SHAW.

Tickets may be procured of Messrs. Carter & Hendee, corner of School and Washington streets; price $2 for adults, $1 for minors.

By direction of the Managers.
HORATIO ROBINSON, Rec. Sec.

At a meeting of the Managers held on the fourteenth of September, it was ordered that the following Resolutions be republished:

1st. Resolved, That a premium in books, be awarded to the author, being a minor, of the best Essay on any subject connected with Trade, Commerce, or Manufactures; the Essay to be delivered to the Recording Secretary before the first of January, 1831.

2d. Resolved, That a premium in books, be awarded to the several authors, being minors, of the three best Abstracts of the Lectures of the next session: the Abstracts to be written in a fair hand, and to be delivered to the Recording Secretary within one month of the termination of the course of lectures.